FLIGHT

First Aero Weekly in the World.

Founder and Editor: STANLEY SPOONER.

A Journal devoted to the Interests, Practice, and Progress of Aerial Locomotion and Transport.

OFFICIAL ORGAN OF THE ROYAL AERO CLUB OF THE UNITED KINGDOM.

No. 324. (No. 11. Vol. VII.)] MARCH 12, 1915. [Registered at the G.P.O. as a Newspaper.] [Weekly, Price 3d. Post Free, 3½d.

Flight.

Editorial Office: 44, ST. MARTIN'S LANE, LONDON, W.C.

Telegrams: Truditur, Westrand, London. Telephone: Gerrard 1828.

Annual Subscription Rates, Post Free.

United Kingdom ... 15s. 0d. Abroad ... ... 20s. 0d.

CONTENTS.

With regard to photographs and descriptions of new British machines and those of our Allies, and other information which may be of help to our enemies, it should be noted that the Editor of FLIGHT, *in the National interest, submits all matter of this character to the Official Press Censor before publication. Hence our readers will appreciate that many new departures in construction or advances in detail work are necessarily held back for the present rather than the smallest risk should be run of helping those who are so strenuously fighting the Allies for the enforcement of their "Kultured" militarism.*—ED.

EDITORIAL COMMENT.

Questions and Answers—in Parliament.

It is a thousand pities that there is not some method of procedure in Parliament that can automatically quash idiotic questions which in nine cases out of ten are merely to advertise the name of the questioner, and in any case waste the time of the House of Commons. Presumably, however, the principle of absolute impartiality and freedom of Parliamentary members must for all time stand in the way of any revision which would not be open to abuse. It might, however, be possible to turn down all those questions which have already been dealt with, by referring the ill-informed questioner to such existing information. It should be up to the members to know whether they are traversing ground which has already been covered. By way of illustration, last week one of the Labour members asked the Prime Minister "what precautions were taken by the British forces engaged in operations in Belgium to prevent damage being done to the population and property of the Belgian nation in the course of air raids or land or sea bombardments of towns and villages by British forces." Another representative of labour also asked whether the Government had "any information as to the recent air raid in Belgium, when bombs were dropped indiscriminately, and as a result of one of these men's escapades, five civilians were killed?"

It is hardly surprising that Mr. Asquith answered, to put it mildly, briefly. To the second question he replied that "our information is not to that effect at all"; while in reply to the first, he merely repeated the information that had already been widely made known, viz., that in accordance with the British idea of warfare, such attacks are directed only against points of military significance, every precaution being taken to avoid damage not necessary to the object in view.

How Neutrals can Interfere.

Not content with his first question, the Member for Bradford West on the same day was down for another, this time to the Foreign Secretary, which was even less notable for its perspicacity. It was as to whether "he was willing, inasmuch as Great Britain and her Allies and all neutral Powers were agreed as to the injury which Belgium had already suffered by reason of a quarrel to which she was not a party, to invite suggestions from neutral Powers with a view to avoiding any further devastation of the territories of Belgium or any further destruction of the cities and towns of Belgium by the Great Powers who are contending against each other for mastery."

Could anything be more fatuous under the conditions now prevailing than this "tub-thumping" interpellation? But probably even Sir Edward Grey's terse and cynical reply would not penetrate the thick hides of those who lay themselves out to obtain fame (?) by this form of heckling. For stinging sarcasm this could hardly be surpassed. Sir Edward said that "the only just solution of this question is the evacuation of Belgian territory by German troops, the restoration of her independence, and reparation for the wrong done to her. Unless neutral Powers are prepared to assist in securing that, I do not see what would be gained by inviting suggestions from them."

If neutrals are to dictate what is right and what is wrong to do in such a state of world upheaval as exists at present, they should at least have a clean bill of health themselves as to seeing that the world's recognised civilised usages are respected. Presumably the United States is one neutral in the mind of the member for Bradford West, but it is not clear from a vast number of opinions expressed by U.S. citizens themselves that either that country or some other neutrals have such a clear conscience before civilisation outside the protection of their much-beloved almighty dollars, as to entitle them them to direct the Allies who are fighting for the whole world, other than by joining up with them to effect what the hon. member for Bradford West thinks desirable. In this connection, by way of a scathing indictment of the United States of America, the public plea made last week by New York's leading Congregational Minister, the Revd. Dr. Thomas McLeod, is illuminating.

"If," says Dr. McLeod, "Great Britain were fighting for self-aggrandisement, commercial supremacy, or something purely political, America would do well to stand aside and see the strongest win. But Britain is fighting for civilisation, and for the very principles and ideas upon which the United States was founded, and, to that extent, she is fighting on behalf of the United States as well as herself."

"And what has the United States done to help in the great cause? except to applaud the Mother Country's action, and to stand by with idle hands. Is it right for America to allow her kinsfolk . . . . to shoulder the burden of civilisation, and to do nothing except protest when their pockets are hurt? A nation which thinks only of saving itself at such a time as this will surely lose its own soul, and after the war neither the conqueror nor the conquered will reserve a niche for a nation which is neither hot nor cold. We are urged to cry 'Hands off' and 'Fair play' as if the war was a fight of dogs over a bone, or a test of skill and strength between gladiators, instead of a battle for honour, righteousness, and for morality as against militarism, of fidelity against brute force, of liberty against tyranny. Be neutral, indeed, while right is being led to the scaffold and England is fighting our battle! Such a request is an insult to our national dignity, which should have been answered in no unmistakable manner. Germany may break all the laws of good men—may murder the innocent, may burn, ruin, and raid, may disregard and defy the claims of international and moral law, but not even a word of protest from us. But let Britain, which is carrying the heavy burden which ought to be the burden of the world, appear to be even careless of our supposed commercial rights, and straightway there goes up a vigorous protest.

"Not only are we leaving her to defend and maintain the things we profess to love most, but we are insisting that she must fight the battle with the strictest and most delicate regard to all fine international amenities. *O tempora, O mores!* Let the conflict sway this way or that, for or against the cause of honour and justice, if only the balance of trade in our favour be maintained and enlarged."

Such, by way of a sample, is one American's view of the duties of neutral countries in the great struggle for liberty, honour, and justice that is at present taking place. Under such circumstances let us hear no more suggestions of outsiders dictating rules as to how the Germans are to be induced to vacate Belgium soil.

Branding the Air and Sea Raiders.

Early last month we advocated that the British military and naval authorities should follow the example set by Russia in deciding that, acting in conformity with the general spirit of international conventions as to the bombardment of unfortified towns either from the air or sea, the attacking and sinking of unarmed merchantmen, and the firing of torpedoes at ships carrying non-combatants, the persons taking part in such acts should be considered as criminals, and when captured sent for trial on a charge of murder or attempted murder. When Lord Charles Beresford subsequently, it will be remembered, raised the matter in Parliament, the Prime Minister would go no farther than to say he was not prepared to make any general statement, but that each case, as it came along, must be decided on its merits. It is, however, with considerable satisfaction that we are able now to chronicle the statement of the Secretary of the Admiralty this week that the "Board of Admiralty do not feel justified in extending honourable treatment to the 29 officers and men rescued from submarine U8, as there is strong probability that she has been guilty of attacking and sinking unarmed merchantmen, and firing torpedoes at ships carrying non-combatants, neutrals, and women."

The Admiralty adds: "There is, of course, great difficulty in bringing home particular crimes to any individual German submarine, and it may be that the evidence necessary to establish a conviction will not be obtained until after the conclusion of peace. In the meantime, persons against whom such charges are pending must be the subject of special restriction, cannot be accorded the distinctions of their rank, or be allowed to mingle with other prisoners of war."

The Admiralty is to be heartily congratulated upon its decision, and now that the principle of treating sea raiders as criminals has been officially adopted, we trust the Government will not hesitate to bracket with these pirates any air-raiders, guilty of bombarding unfortified places, who may be secured.

The Roll of Honour.

THE following casualties in the British Expeditionary Force have been reported from the General Headquarters in France:—

Under date of March 1st:

Missing.

Second Lieut. M. R. Chidson, Royal Garrison Artillery and R.F.C.
Second Lieut. D. C. W. Sanders, Royal Field Artillery and R.F.C.

Under date of March 4th:

Wounded.

Second Lieut. V. H. N. Wadham, Hampshire Regiment and R.F.C.

Naval Commands on the Continent.

THE following note was issued through the Official Press Bureau on the 4th inst.:—

"With reference to statements which have appeared in some newspapers, the Secretary of the Admiralty announces that Commander Samson, R.N., is in command of armoured cars, aeroplanes, &c., on the Continent, and that the officer in command of all British armoured trains is Commander A. Scott Littlejohns, R.N."

FLIGHT

AIRCRAFT WORK AT THE FRONT.

OFFICIAL INFORMATION.

IN an Admiralty announcement, issued on the 3rd inst. regarding the shelling of the Dardanelles forts, it was stated :—

"The operations in the Dardanelles were resumed at 11 o'clock last Monday morning, when His Majesty's ships 'Triumph,' 'Ocean,' and 'Albion' entered the Straits and attacked Fort No. 8 and the batteries at White Cliff. The fire was returned by the forts and also by field guns and howitzers.

"An air reconnaissance made by naval seaplanes in the evening reported that several new gun positions had been prepared by the enemy, but that no guns had been erected in them. The seaplanes also located a line of surface mines. During Monday night a force of mine-sweepers, covered by destroyers, swept within a mile and a half of Cape Kephez, and their work, which was carried out under fire, is reported to have been excellent. . . . .

"On Tuesday seaplane reconnaissance was impossible on account of the weather."

In the announcement issued by the Admiralty on Saturday night there was the following :—

"No action was possible on the 3rd till 2 p.m., when, although the weather was still unfavourable, 'Irresistible,' 'Albion,' 'Prince George,' and 'Triumph' resumed the attack on Fort Dardanus and the concealed guns in its neighbourhood. These were less active than before, and were dealt with by the ships with more certainty. A useful seaplane reconnaissance located several encampments and two permanent batteries."

In the announcement issued by the Admiralty on Monday night there was the following :—

"Owing to the importance of locating the concealed guns the seaplanes have had to fly very low on occasions. On the 4th instant a seaplane (pilot Flight-Lieutenant Garnett, observer Lieutenant-Commander Williamson) became unstable and nose-dived into the sea, both officers being injured. Flight-Lieutenant Douglas, reconnoitring at close quarters in another seaplane, was wounded, but managed to return safely. On the 5th, seaplane No. 172 (pilot Flight-Lieutenant Bromet, with Lieutenant Brown) was hit no fewer than twenty-eight times, and seaplane No. 7 (pilot Flight-Lieutenant Kershaw, with Petty Officer Merchant) eight times in locating concealed positions. The 'Ark Royal' is equipped with every appliance necessary for the repair and maintenance of the numerous aircraft she carries."

The following announcement was issued by the Admiralty on Tuesday :—

"Wing Commander Longmore reports that an air attack on Ostend was carried out yesterday afternoon by six aeroplanes of the Naval Wing. Of these two had to return owing to the petrol freezing. The remainder reached Ostend and dropped 11 bombs on the submarine repair base and 4 bombs on the Kursaal, the headquarters of the military. All machines and pilots returned.

'It is probable that considerable damage was done. No submarines were seen in the basin.

"The attack was carried out in a fresh N.N.W. wind."

The Admiralty on Tuesday night communicated the following extract from *De Tijd* (February 22nd, 1915) :—

"The Raid of the British Airmen,

"Sluis, February, 21st.

"The general opinion of the public is, that the raid of the British airmen was intended rather to obtain a moral effect, than to cause material damage. I was of the same opinion, until what I saw with my own eyes, and what I learnt from very reliable sources, made me change my mind. Besides the thirteen soldiers killed, and the thirty-five wounded in the Blankenberghe tram, and the submarine badly damaged at Zeebrugge, several batteries along the coast have greatly suffered, and a large number of guns have been totally destroyed. At Knocke, one officer and seven men were killed, as well as many artillerymen. The bombs did not kill any civilian, nor touch any house."

In the bi-weekly report from Sir John French, issued on March 4th, it was stated :—

"On March 2nd one of our aeroplanes, flying behind the German lines, twice attacked single German machines and forced them both to descend."

In the French official *communique* issued at midnight on the 4th inst., it was stated :—

"Near Verdun, at the Fort of Vaux, a German aeroplane was brought down within our lines, and two aviators were taken prisoners."

The following official note was also issued in Paris on the 4th inst. :—

"One of our aviators, Captain Happe, yesterday bombarded the German powder magazine at Rottweil (twenty-three kilomètres north of Donaueschingen). His success was complete. Ten minutes after throwing the bombs the powder magazine was on fire, the flames rising to a height of 400 mètres.

"The whole distance covered by the aviator was 300 kilomètres (about 186 miles).

"A German aeroplane threw bombs on the hospital of Gerardmer, but there were no victims and no damage was done."

This was supplemented on the next day by the following :—

"The powder works at Rottweil are one of the most important establishments of the kind in Germany. Rottweil is situated on the Neckar, on the other side of the Black Forest, at a distance of 93 miles from Belfort as the crow flies. One of our airmen descended as low as 5,000 ft. over the works in order to throw his bombs with the greater accuracy. He succeeded in dropping four 3½in. melinite shells, the first on the acid tanks and the other three on the works themselves.

"The projectile dropped on the tanks caused blue smoke to shoot up, which the airman at first took for the smoke of a gun fired on himself. Soon after a huge flame rose from the same spot, with columns of thick smoke, which reached as high as the aeroplane (5,000 ft.).

"The pilot hovered for ten minutes above the works in order to observe the effects of his projectiles. He was thus able to note that besides the principal outbreak flames were shooting up from different points, the conflagrations being caused by the explosion of the other bombs."

An official note issued in Paris on the 5th inst. contained the following information :—

"M. Pégoud, the famous French aviator, has received the Military Medal for having on several occasions pursued enemy aircraft. On February 5th, he attacked and brought down a German aeroplane at a great height. A short time afterwards he attacked two others, bringing down one and obliging the other to descend."

The following official statistics regarding the aerial services carried out from the beginning of mobilisation up to January 31st by the French aviators, were issued in Paris on Sunday last :—

"The whole of the old and new squadrons carried out

about 10,000 reconnaissances during eight months of war, corresponding to more than 18,000 hours of flight. In order to form an idea of what was accomplished, it is sufficient to observe that these flights put together represent a distance traversed of 1,800,000 kiloms., or 45 times round the world. These remarkable results were not obtained without grievous losses, which are comparable to, and often more severe than, those of other arms, so far as the number of killed, wounded, and missing is concerned."

It was announced in Petrograd on March 5th that in the fighting around Przasnysz the Russians took 12 guns, 29 machine guns, 122 ammunition wagons, an aeroplane, and a number of trains.

In a semi-official statement issued in Petrograd on March 8th there was the following :—

"The Austrians keep up a particularly violent fire on our aviators, who fly over the fortress (Przemysl) almost daily. On March 5th our fire brought down a German aeroplane of the Albatros type near the station of Sokolka. The aviators were made prisoners."

An official *communique* issued in Petrograd on the 9th stated :—

"Our aviators successfully dropped bombs on Czuczine and Stavisk."

THE BRITISH AIR SERVICES.

UNDER this heading are published each week the official announcements of appointments and promotions affecting the Royal Naval Air Service and the Royal Flying Corps (Military Wing) and Central Flying School. These notices are not duplicated. By way of instance, when an appointment to the Royal Naval Air Service is announced by the Admiralty it is published forthwith, but subsequently, when it appears in the LONDON GAZETTE, *it is not repeated in this column.*

Royal Naval Air Service.

THE following was announced by the Admiralty on the 3rd inst.:

Acting Sub-Lieut. L. H. Hardstaff, R.N.R., transferred to the Royal Naval Air Service as Probationary Sub-Lieutenant, and appointed to the "President," additional, for R.N.A.S. To date Feb. 3rd.

The following was announced by the Admiralty on the 6th inst. :—

Mr. T. C. Vernon entered as Probationary Flight Sub-Lieutenant, and appointed to the "President," additional, for R.N.A.S. To date March 5th.

The following was announced by the Admiralty on the 8th inst. :—

R. G. Mack entered as Probationary Flight Sub-Lieutenant, and appointed to the "President," for Royal Naval Air Service. To date March 6th.

The following appeared in the *London Gazette* issued on the 9th inst. :—

With reference to the notice which appeared in the *London Gazette* of Friday, Feb. 26th, 1915, the seniority of Flight Sub-Lieut. H. J. Batchelor should be Nov. 15th, 1914, and not as therein stated.

Royal Flying Corps (Military Wing).

THE following appeared in a supplement to the *London Gazette* issued on the 3rd inst. :—

The undermentioned appointment is made :

Equipment Officer.—Second Lieut. R. H. Collier, Special Reserve, and to be temporary Captain, vice temporary Capt. F. C. Jenkins, Special Reserve. Dated Feb. 16th, 1915.

Special Reserve. Supplementary to Regular Corps.—The probationary appointments of the undermentioned Second Lieutenants are cancelled : R. C. Freeman ; dated Feb. 4th, 1915. M. V. Morgan ; dated Feb. 13th, 1915.

Second Lieut. (on probation) C. C. Wigram is confirmed in his rank.

L. W. Yule to be Second Lieutenant (on probation). Dated Sept. 17th, 1914, but not to carry pay or allowances prior to Dec. 23rd, 1914.

H. R. Nicholl to be Second Lieutenant (on probation). Dated Feb. 16th, 1915.

The following appeared in the *London Gazette* issued on the 5th inst. :—

Special Reserve. Supplementary to Regular Corps.—The undermentioned Second Lieutenants (on probation) are confirmed in their rank : J. J. Hammond and F. W. Goodden.

C. D. Fuller to be Second Lieutenant (on probation). Dated Jan. 28th, 1915.

The following appeared in a supplement to the *London Gazette* issued on the 6th inst. :—

The undermentioned appointment is made :

Flying Officer : Lieut.-Col. Sir B. B. M. Leighton, Bart., Territorial Force Reserve, from the Reserve. Dated Feb. 5th, 1915.

Special Reserve. Supplementary to Regular Corps.—Second Lieut. B. C. Hucks to be Lieutenant. Dated Feb. 15th, 1915.

The following appeared in a supplement to the *London Gazette* issued on the 8th inst. :—

The undermentioned appointment is made :

Equipment Officer.—Lieut. (temporary Capt.) J. Valentine, Special Reserve, a Flying Officer. Dated February 8th, 1915.

The following appeared in the *London Gazette* issued on the 9th inst. :—

The undermentioned appointments are made :

Squadron Commanders ; Lieut. (temporary Capt.) G. I. Carmichael, Royal Artillery, a Flight Commander, and to be temporary Major ; dated March 2nd, 1915. Capt. U. J. D. Bourke, Oxfordshire and Buckinghamshire Light Infantry, a Flight Commander, and to be temporary Major ; dated March 2nd, 1915. Major T. I. Webb-Bowen, Bedfordshire Regiment, from Assistant Commandant Central Flying School ; dated March 6th, 1915.

Flying Officer : Lieut. C. W. Anstey, South Wales Borderers, and to be seconded. Dated Feb. 26th, 1915.

Special Reserve. Supplementary to Regular Corps.—H. T. Musker to be Second Lieutenant (on probation). Dated March 10th, 1915.

The undermentioned non-commissioned officer to be Second Lieutenant for service in the field :—

The King's Own (Royal Lancaster Regiment). Corporal W. H. Nixon, from Royal Flying Corps. Dated Feb. 14th, 1915.

The following appeared in a supplement to the *London Gazette* issued on the 10th inst. :—

The following appointment is made :

Flight-Commander : Capt. John C. Halahan, Reserve of Officers, from a Flying Officer. Dated March 1st, 1915.

Special Reserve. Supplementary to Regular Corps.—To be Second Lieutenants (on probation) ; Feb. 20th, 1915 : Arthur R. H. Browne, Robert E. A. W. Hughes-Chamberlain, Arthur M. Cott. Dated March 4th, 1915.

Central Flying School.

THE following appeared in the *London Gazette* issued on the 9th inst. :—

The undermentioned appointment is made :

Assistant Commandant (graded as Wing Commander) :—Capt. (temporary Major) D. Le G. Pitcher, 39th King George's Own Central India Horse, Indian Army, from a Squadron Commander, and to be temporary Lieutenant-Colonel, vice Major T. I. Webb-Bowen, Bedfordshire Regiment. Dated March 6th, 1915.

Military Aviation in South Africa.

ACCORDING to an announcement in the *Cape Times Weekly* of February 12th, the Governor General of South Africa has appointed the undermentioned officers of the Active Citizen Force to commissioned rank in the Permanent Force (Staff) of the Union Defence Forces :—

As Captain, Gerard Percy Wallace, from Lieutenant, South African Aviation Corps ; as Lieutenants, Basil Hobson Turner, Kenneth Reid van der Spuy, and Gordon Shergold Creed, from Lieutenants, South African Aviation Corps ; as Lieutenant (on probation), Edwin Cheere Emmett, from Lieutenant, South African Aviation Corps.

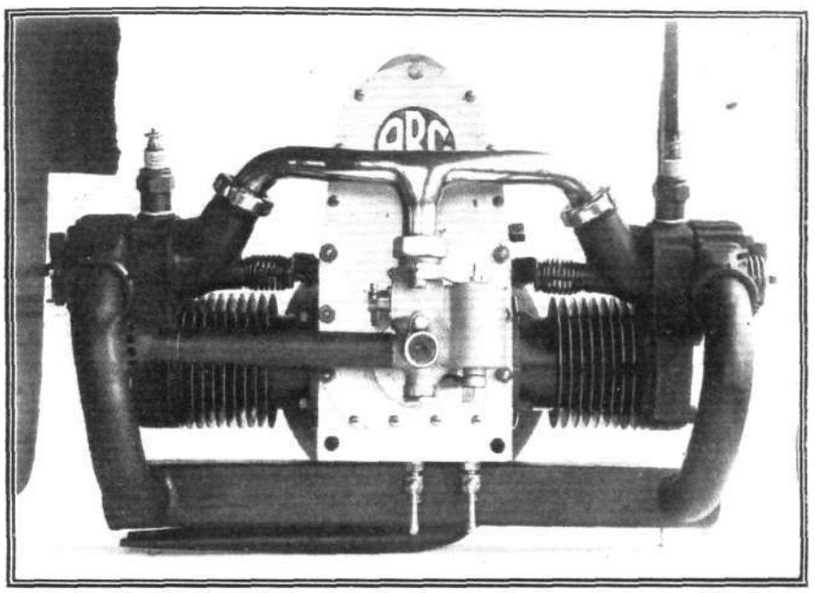
His Excellency has appointed the above-mentioned to the Instructional and Administrative Staff of the Union Defence Forces.

FLIGHT

THE A.B.C. AUXILIARY MOTOR.

A 6 H.P. PETROL ENGINE FOR ENGINE STARTING, AND FOR DRIVING LIGHTING, WIRELESS OR BLOWING SETS.

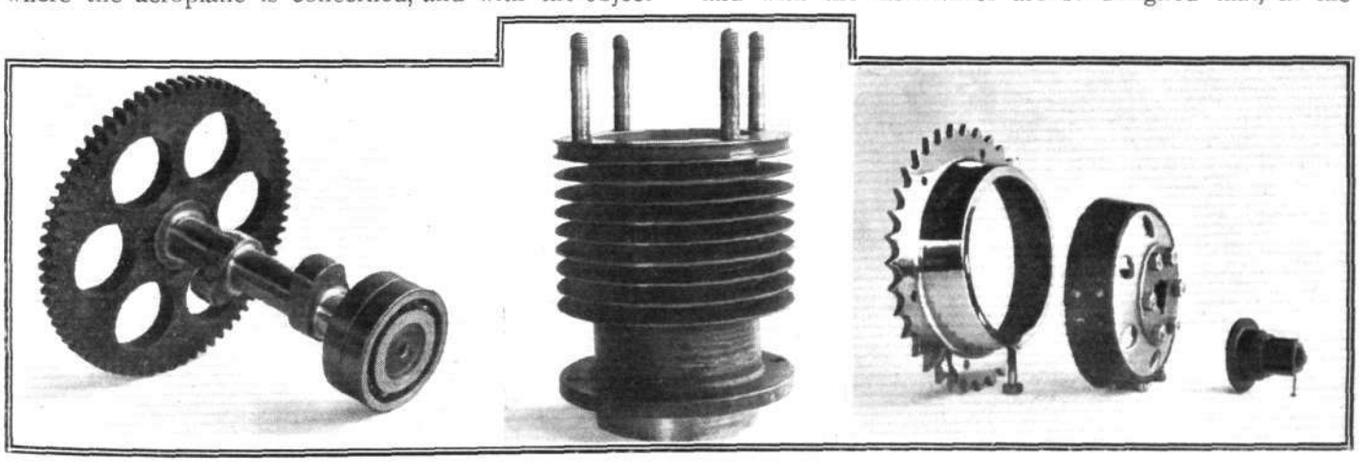
WITH the gradual tendency exhibited in modern practice towards the development of larger and more powerful aeroplanes, especially those of the seaplane type, the desirability of providing some mechanical device which will enable the pilot to start the engine, without outside assistance, becomes increasingly evident. Coupled also with this is the fact that the use of wireless apparatus is becoming more extensive on military machines; and where any night operations are contemplated, the utility of a lighting set for the purpose of signalling to or illuminating the ground upon which the pilot may desire to land, will be readily appreciated.



The 6 h.p. A.B.C. auxiliary motor viewed from the carburettor side.

Weight and space are, however, important factors where the aeroplane is concerned, and with the object of producing an engine that would occupy the minimum of space, involve the smallest possible increase in weight, and be able to either turn the engine or drive the dynamo, according to the requirements of the moment, the A.B.C. Road Motors, Ltd., of Hersham, Walton-on-Thames, and their chief engineer (Mr. Granville E. Bradshaw) have applied the results of their extended experience in aeronautical and high speed engine design upon the design of their new auxiliary motor.

The engine, which is of the two-cylinder opposed type, is air-cooled, and develops its rated horse-power (6 h.p.) at 3,300 revolutions per minute, which corresponds to a torque of 115 lb. ins. The arrangement of the cylinders and cranks employed is such as to tend naturally to reduce vibration to the minimum; and the claim is made, that it is possible to hold the engine in the hand when it is running at a speed of 4,000 revs. per minute. The cylinders are of steel, machined from the solid bar; but the heads, which are detachable, as may be seen from one of our photographs, are of cast iron—as are also the pistons—and are held in position by four steel studs. To ensure an entire absence of gas leakage at the joint between the head and the cylinder body, ample width has been provided for the jointing surface. All bearings throughout the engine, with the exception of that at the small end of the connecting rod, are of either the ball or the roller type, and lubricating oil is supplied through adjustable drip feeds from an oil tank placed immediately over the engine. Provision is made for determining the level of oil in the crank-case by fitting two cocks in the lower portion, the upper of which gives the correct level of oil. The crank-shaft is a one-piece forging of high tensile steel, as is also the single cam-shaft which operates the inlet and exhaust-valves in both cylinders, through the four hanging tappet levers, by two cams, thus giving perfect synchronisation and even running. The exhaust-valves are located in the cylinder-heads, and with the inlet-valves are so designed that, in the remote event of the valves breaking, the heads will not fall into the cylinder.



DETAILS OF THE 6 H.P. A.B.C. AUXILIARY MOTOR.—On the left is the ball-bearing camshaft with timing wheel in position; in the centre is one of the cylinders with the head removed; and on the right is the chain wheel and clutch details for coupling up the motor to the engine.

The engine is supplied completely equipped ready for running, except for the connection to the petrol tank; and the weight of 59 lbs. includes the magneto, Claudel

Hobson carburettor, induction and exhaust pipes, flywheel, starting lever, flexible coupling and all wires and connections. Where it is intended to use the engine in connection with a wireless set or for driving blowers for the ballonets of airships, a speed governor driven from the magneto shaft is also fitted; and if special importance is attributed to lightness, the weight quoted above can be reduced by a few pounds. This motor may be started from the pilot's seat, as the geared-up ratchet lever provided can be carried thereto by an extension rod, wherever the engine may be located, and without appreciably increasing the weight of the set.

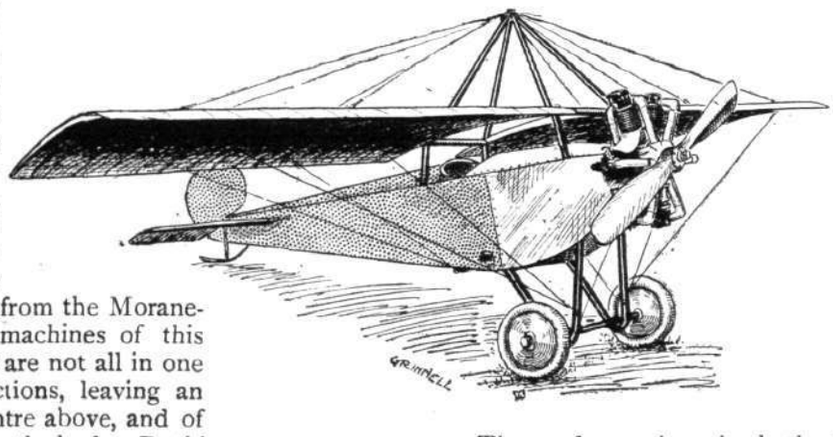
The clutch is mounted upon the extremity of the crank-shaft remote from the starting end, and consists, as will be seen from one of our photographs, of a female member upon which the sprocket for driving the main engine is mounted, and a male conical sliding member faced on its periphery with a special clutch lining. Normally, the male portion is held out of engagement with the outside member by a spring — exactly the opposite action to that which is arranged for in the ordinary car clutch. When it is desired to start up the main engine, the pilot starts up the auxiliary motor by pulling the ratchet lever, gradually opens the throttle, and pushes in the clutch. As soon as the main engine commences to run under its own power, the clutch lever is released and the clutch disengages under spring action. It is stated that this auxiliary motor will start up an average engine of about 250 h.p. from cold, with ease, and will keep it running at about 300 revs. per min. for so long as petrol and oil are fed to it. The engine is supplied with or without the main engine starting equipment; but the latter can be added without difficulty, and the attachment to the main engine by chain can be readily effected.

In designing the unit, every endeavour has been made to simplify the construction as much as possible, and to eliminate all parts that could be dispensed with, without impairing any of its desirable qualities, and the result appears to be in every way satisfactory. The importance of ready access to such parts as are most likely to receive attention was also borne in mind, and a large end door on the crankcase renders inspection of the whole of the interior a matter of only a few minutes' work. Obviously the application of the power unit is not limited to the particular uses we have specified. Although its lightness, combined with strength and reliability render it specially adapted for use on aeroplanes and airships, these same qualities are also eminently desirable where transport difficulties are encountered, and, therefore, it should find ready acceptance for portable field wireless and lighting sets.

⊛ ⊛ ⊛ ⊛

AN AMERICAN "PARASOL" MONOPLANE— THE GRINNELL.

IN general design, several of the latest aeroplanes built in the United States have followed, more or less closely, European practice. From this it must not be inferred that they lack originality, for the latter is to be found in constructional details, whilst in some cases traces of American practice still remain. One of these "European" models that has given very satisfactory results is the Grinnell monoplane, designed by William C. Robinson and built by the Grinnell Aeroplane Co. of Grinnell, Iowa. This machine is of the "Parasol" type, *i.e.* having the wings mounted above the body, a practice introduced some little time back by the Morane-Saulnier and Blériot firms, which has proved its worth on active service. The principal advantages of this type are an increased range of vision, and, so it has been claimed, an inprovement in stability. The Grinnell parasol differs from the Morane-Saulnier and Blériot machines of this type in that the wings are not all in one piece, but in two sections, leaving an open space in the centre above, and of about the same width as, the body. By this arrangement an unobstructed view upwards is obtained, and in this respect it is certainly an improvement, but it would be interesting to know if the space in the centre of the wings has any effect aerodynamically. The wings, which are rectangular in plan-form, are supported above the body by two pairs of short tubular struts. The front and rear pairs of these struts are each connected to a horizontal tubular member which receives the inner ends of the front and rear wing-spars respectively—forming, in fact, continuations of the spars. Four tubular extensions of the short struts form a pyramid above the wings from which the latter are braced.



The rectangular body is not unlike that of the Nieuport monoplane, and in the nose is mounted the 100 h.p. engine. The latter is also of Robinson's own design, and is a 6-cyl. radial (fixed) air-cooled engine having a bore and stroke of 5 ins. and 6 ins. respectively. Behind the engine are the fuel tanks, and behind these again are the pilot's and passenger's seats, arranged side by side. The front portion of the body forward of the cockpit is covered with sheet aluminium, and the remainder with fabric. The tail consists of two almost rectangular stabilising surfaces, mounted on either side of the rear extremity of the body, with elevator flaps hinged to the trailing edges. A peculiar feature of the stabilising surface is that the leading edge is curved forwards where the abutment against the body takes place, so that a kind of peak is formed. Pivoted to the stern-post of the body is a circular-shaped partially balanced vertical rudder.

The under-carriage is both simple and strong. It consists of two tubular steel U struts, to the lower extremities of which are sprung the two running wheels. The front under wing-bracing cables are anchored to the forward members of the U struts, whilst the rear under bracing or warp cables are carried by the lower longitudinals of the body. It was on this machine that W. C. Robinson put up the American cross-country record last October (375 miles in 4 hrs. 44 mins.). The principal dimensions of the Grinnell monoplane are:—Span 35 ft.; chord 7 ft.; supporting area 225 sq. ft.; overall length 25 ft.; weight empty 900 lbs.; speed about 80 m.p.h.

The Royal Aero Club of the United Kingdom

OFFICIAL NOTICES TO MEMBERS

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Members of the Royal Aero Club of the United Kingdom will be held on Tuesday, March 23rd, 1915, at 5 o'clock, at 166, Piccadilly, London, W.

Committee Election.

The following Members have been nominated :—

Griffith Brewer.
Ernest C. Bucknall.
John D. Dunville.
Col. H. C. L. Holden, C.B., F.R.S.
Prof. A. K. Huntington.
Flight Commander F. K. McClean, R.N.A.S.
Squadron-Commander Alec Ogilvie, R.N.A.S.
Mervyn O'Gorman, C.B.
C. F. Pollock.

SPECIAL COMMITTEE MEETING.

A Special Meeting of the Committee was held on Tuesday, the 9th inst., when there were present: Prof. A. K. Huntington, in the Chair, Mr. Griffith Brewer, Mr. Ernest C. Bucknall, Mr. C. F. Pollock, and the Assistant Secretary.

New Members.—The following New Members were elected :—

Harry Ford.
2nd Lieut. Noel Alexander Hodgkinson.
Samuel Edgar Saunders.
Lieut. Hastings Elwin Taylor, R.N.V.R.
Lady Tredegar.
Herbert Sanford Ward.
Lieut.-Com. Josiah Clement Wedgwood.

Aviators' Certificates.—The granting of the following aviators' certificates was confirmed :—

1097 Stanley Winther Caws (Maurice Farman Biplane, Military Aviation School, Brooklands). Feb. 25th, 1915.
1098 Flight Sub-Lieut. Reginald Alexander John Warneford, R.N.A.S. (Bristol Biplane, Royal Naval Air Station, Hendon). Feb. 25th, 1915.
1099 2nd Lieut. Hugh Vivian Champion de Crespigny (Maurice Farman Biplane, Military Aviation School, Brooklands). Feb. 26th, 1915.
1100 2nd Lieut. Marwood Elton Lane, R.F.C. (Maurice Farman Biplane, Military Aviation School, Brooklands). March 2nd, 1915.
1101 Oliver Dwight Filley (Maurice Farman Biplane, Military Aviation School, Brooklands). March 2nd, 1915.

The following Aviator's Certificate was granted :—

1102 John Halstead Moore (L. and P. Biplane, London and Provincial Aviation School, Hendon). March 4th, 1915.

Alteration to Club Rule No. 7.—On the motion of Mr. C. F. Pollock, seconded by Mr. Ernest C. Bucknall, it was unanimously resolved that Club Rule No. 7 be altered by adding the words :

"In the event of the number of candidates nominated for election to the Committee not exceeding the number of vacancies, no ballot paper shall be sent, the candidates so nominated being *ipso facto* elected."

This alteration will be submitted for confirmation of the Members of the Club at the Annual General Meeting.

The rule now reads as follows :—

"7. *Ballot Papers.*—Not less than 7 days before the Annual General Meeting a ballot paper shall be posted to every Member. The ballot paper shall contain the names of Candidates nominated for the Committee in the form of an alphabetical list. The same type is to be used throughout. In the event of the number of candidates nominated for election to the Committee not exceeding the number of vacancies, no ballot paper shall be sent, the candidates so nominated being *ipso facto* elected."

THE FLYING SERVICES FUND.

Administered by The Royal Aero Club.

THE Lords Commissioners of the Admiralty and the Army Council having signified their approval, the Royal Aero Club has instituted and will administer a fund originated by M. André Michelin for the benefit of officers and men of the Royal Naval Air Service and the Royal Flying Corps who are incapacitated on active service, and for the widows and dependents of those who are killed.

The fund is intended for the benefit of all ranks, but especially for petty officers, non-commissioned officers and men.

In view of the great utility of the work of the Flying Services, evidence of which has been repeatedly given in the official despatches of the Commander-in-Chief, the skilful and daring flights into enemy country, and the protection afforded by the continuous patrolling of our coast by aircraft, it is confidently expected that the British public will welcome this opportunity of showing their appreciation by subscribing promptly and liberally to the fund.

The Right Hon. Lord Kinnaird has kindly consented to act as Honorary Treasurer to the Fund.

Subscriptions should be forwarded to The Flying Services Fund, The Royal Aero Club, 166, Piccadilly, London, W., or to Barclay and Co., Ltd., 1, Pall Mall East, London, S.W. Cheques should be crossed "Barclay and Co., Ltd."

TULLIBARDINE, Brig.-General,
Chairman of the Royal Aero Club.

	£	s.	d.
Total Subscriptions received to March 3rd, 1915 ...	7,177	7	6
Employés of Messrs. A. V. Roe & Co., Ltd., for 5 weeks to February 26th, 1915	32	1	11
The North British Rubber Co., Ltd.	10	10	0
Ernest Pitman ...	1	1	0
Officers of the Royal Naval Air Service at Great Yarmouth	6	0	0
R. G. Tumber ...	0	2	6
Miss B. Ewart ...	0	2	6
Collected by the London and Provincial Aviation Co. ...	2	15	6
Miss Margaret A. Graham	1	1	6
Mrs. E. N. Harrild...	3	3	0
Officers of the Royal Naval Air Service at Eastchurch ...	31	8	0
"No. 13"	100	0	0
Straker-Squire (1913) Ltd.	10	10	0
Total, March 10th, 1915 ...	£7,376	3	5

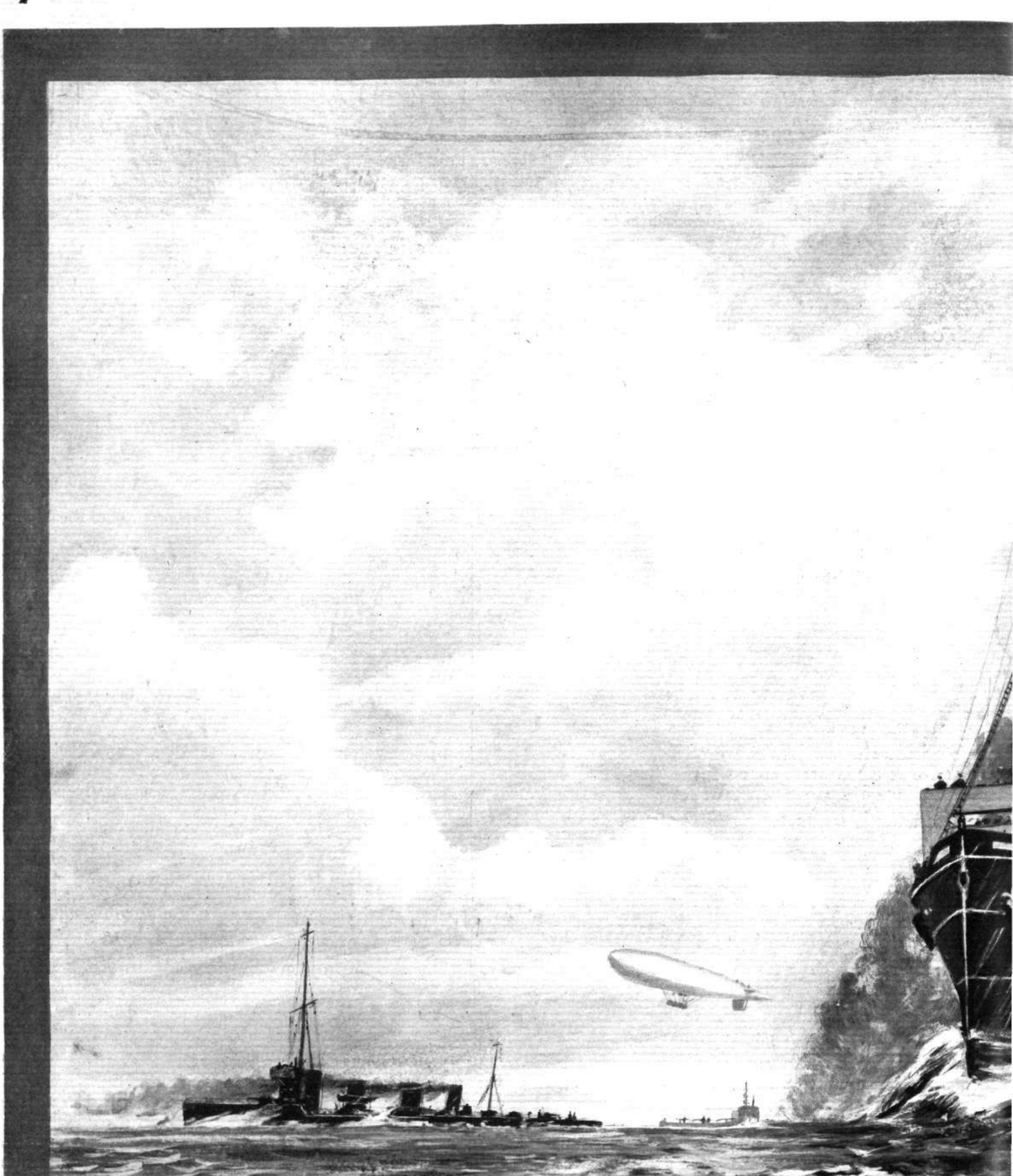
166, Piccadilly, W. B. STEVENSON, Assistant Secretary.

The Air Raid on Essex.

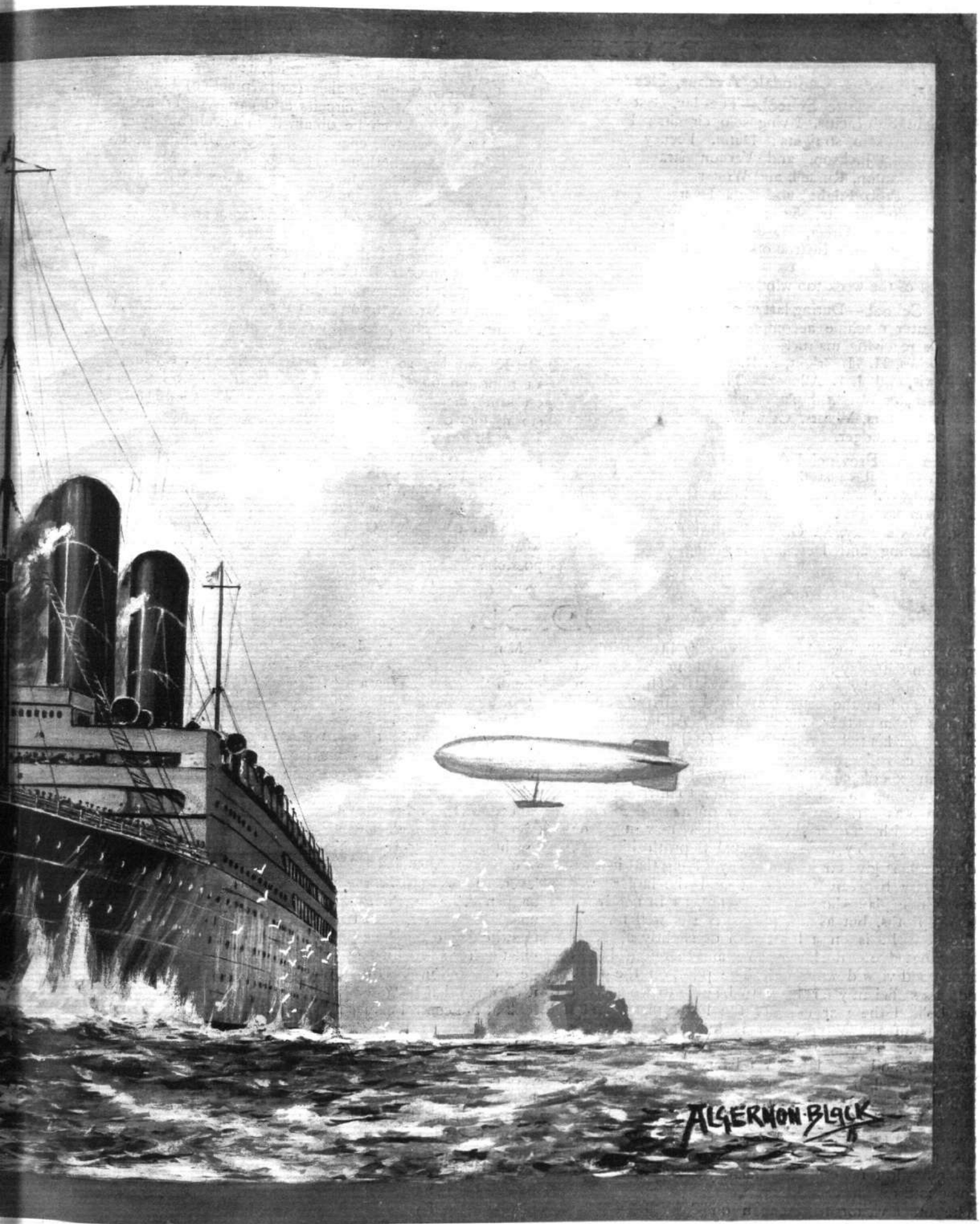
IT is officially announced that the terms of reference of the East Coast Raid Committee have been extended so as to cover the damage sustained during the recent air raid on Colchester and the neighbouring district, with a view to relief being given from Imperial funds to the persons affected, on the same lines as in the cases of the bombardments of the Hartlepools, Scarborough, and Whitby, and of the Norfolk air raid. All communications to the committee should be addressed to the secretary, Mr. Aubrey T. Laurence, Board of Education, Whitehall, S.W.

The German Airship Disasters.

WITH reference to the French official note referring to Germany's airship losses, which was given in FLIGHT last week, Mr. L. F. Hutcheon writes to point out that the reference to the wreck of L1 on September 9th *last* is wrong, as that airship was lost on the date mentioned in 1913, while the L2 was destroyed on October 17th, 1913.



GUARDING BRITISH TRANSPORTS.—Our forces have been so successfully convoyed to France un
first drafts of the Expeditionary Force up to the present time. In the above striking picture by Mr. Algern
prominent position, their value being recognised by the Admiralty, not only for this purpose but for scouting a
fleet, and for the detection of and, if opportunit



protection of our Navy and our aircraft that not a single mishap has been recorded, from the sending over of the
ck of a batch of transports under convoy, our mobile dirigibles, the Astra-Torres and the Parseval, occupy a
e French and Belgian Coasts, and generally cruising over the Channel and home waters for signs of the enemy's
d serve, for attacking the German pirate submarines.

FROM THE BRITISH FLYING GROUNDS.

London Aerodrome, Collindale Avenue, Hendon.

Grahame-White School.—Tuesday, last week, Prob. Flight Sub-Lieuts. Irving solo circuits; Ferrand and Morrison solo straights; Dunn, Feeney, Greer, Hards, Hood, Jackson, and Vernon straights with Instructors Manton, Russell, and Winter.

Thursday, Prob. Flight Sub-Lieuts. Irving, Dunn, and Morrison solo circuits, &c.; Dunn, Ferrand solo straights; Feeney, Greer, Hards, Hood, Jackson, and Vernon straights with Instructors Russell, Winter, and Manton.

The rest of the week too windy for pupils.

Beatty School.—During last week pupils were out on the two seater machine accompanied by the instructor, the pupils receiving instruction being Messrs. Ormsby, Gerrit Forbes, H. H. Bright, F. R. Laver, J. H. Vickers, B. B. Lewis, and J. L. Allcock. The machines in use were two-seater Wright biplanes with controls in duplicate. Instructors, Messrs. Geo. W. Beatty, W. Roche-Kelly and C. Prodger.

London and Provincial Aviation Co.—Tuesday, last week, M. G. Smiles test flight 10 mins., Messrs. Noakes and Bransby Williams circuits and eights (extra practice). Mr. Watson straights, Messrs. Deschamps and Faning rolling. Wednesday, M. G. Smiles test flight 15 mins., Messrs. Faning and Deschamps rolling, Mr. Watson straights.

Thursday, test flight, M. G. Smiles, 10 mins. Messrs. Bransby Williams and Noakes (extra practice) circuits and eights. Mr. Moore circuits and eights, afterwards flying for *brevet* which he obtained in excellent style, despite adverse weather conditions. Messrs. Faning and Deschamps rolling, both making good progress. Messrs. Watson and Abbott straights.

Friday and Saturday, gale blowing.

Instructors for the week, W. T. Warren and M. G. Smiles.

Ruffy-Baumann School.—Monday last week, Mr. E. Roobaert and Mr. B. C. Bell, joined the school.

Tuesday, E. Baumann out on 60 Caudron giving instruction to Mr. Kenworthy, 10 mins., Mr. Blandy, 11 mins. Mr. H. James out testing 45 Caudron.

Wednesday, test flight on 60 Caudron. Thursday, Mr. Kenworthy, 10 mins. on 60 Caudron, Mr. Hydon, 11 mins. on 60 Caudron. Mr. B. C. Bell, first lesson on same machine with E. Baumann. Week end too stormy for school work. Instructors, E. Baumann and James Brothers.

Northern Aircraft Co., Ltd.

The Seaplane School, Windermere.—On Friday, last week, Mr. W. Rowland Ding took out the Avro, which has been fitted with dual control, but found it too rough to continue. Owing to the inclemency of the weather all through the week no tuition work has been possible.

EDDIES.

OWING to the high wind, there was very little flying at Hendon on Saturday last, but the monotony was relieved in the morning by a short flight by Mr. Graham on "Lizzie," and in the afternoon by the arrival of two machines from other aerodromes. Although only qualifying for his ticket recently, Mr. Graham is already acquiring considerable experience in rough weather flying—an experience which he never loses any opportunity of adding to. The first visitor to arrive in the afternoon was Mr. Harry Hawker on a tandem two-seater Sopwith tractor biplane. This new machine differs considerably from the usual Sopwith biplanes, and I can best give an idea of it by saying that it is an intermediary between the Scout and the larger two-seater. The planes are not staggered, as in nearly all other Sopwiths, but as the passenger sits well forward in the body he is on a level with or slightly ahead of the leading edge of the lower plane, and therefore obtains quite a good view downwards. The pilot, on the other hand, sits sufficiently far back to be able to see straight down behind the rear edge of the lower plane. The chassis is of the V-type, and is built of steel tubes throughout. The machine has a very business-like appearance, and Mr. Hawker tells me that she climbs exceedingly well, besides being easy to handle and comfortable to fly. To those who had not had the opportunity to see Hawker's piloting for the last few months, it was quite a treat to watch him coming in from Brooklands, travelling at a great pace. and to note that his piloting has lost none of its brilliancy since the days of looping and race meetings.

The other visitor to Hendon on Saturday last was Capt. Halahan, who in a B.E. flew over from Farnborough with a passenger, returning again later in the afternoon, in a very nasty wind.

Minor mishaps are, I suppose, to be considered as being all in the day's work of a school instructor, but one of the most unpleasant experiences that I have heard of for a long time happened to Mr. Merriam the other day up at Hendon. Merriam had just been up to a height of 2,000 ft., to test the air, and was giving the 'bus over to one of his pupils for solo flights. The pupil, however, expressed the wish that Merriam would take him for a flight across the ground in order to show him where to land at the other side when doing straights. Merriam consented, and they started off, reaching a height of about 40 ft., when suddenly Merriam felt a lot of cables tangle themselves round his legs and the control lever. Looking over the side to find out what had happened, he saw the *ailerons* flapping about in a most unseemly manner, and, I need hardly say, lost no time in switching off and getting down. By vigorous manipulation (or should it be "pedipulation"?) of the rudder he succeeded in effecting a safe landing. You may take it from me that both he and the pupil always have a good look at the control cables now before going up.

× × ×

In the comparatively few moments that he can spare from his instruction work, Manton is getting in some very useful practice on the new Grahame-White tractor biplane. Manton tells me that he is now beginning to get used to the high speed of this machine, and rather enjoys flying her, He has found out, though, that it's a bit tricky to attempt to look over the side too much, as the wind at that high speed seems to have a nasty habit of catching hold of your nose and twisting your head round if you don't get it back behind the wind screen in quick time. Although fitted with a rigid chassis, it is fairly easy to land, as the minimum speed is so low.

Pupils at the Beatty school are discussing, and looking forward to the materialisation of a new tractor biplane for school work, which it is intended to build in the near future, but as the working drawings have not yet been completed, it is a bit early to give any detailed description of the new construction, and, broadly, the design is for a *fuselage* biplane with the engine in front and pilot at the rear, and is expected to rank as a "Tweenie" with the Wright machine and the faster tractor machines that the pupils will have to fly after leaving school, and should on that account alone be a very useful and much sought after addition to the Beatty *entourage*.

× × ×

Appropos of the Beatty school, Mr. Francis, who has up to now been manager for Mr. Beatty, is joining the Hall Aviation Co., where his long experience of construction and school work should prove a considerable asset.

× × ×

An ardent reader of FLIGHT has pointed out to me that the "Eddy" last week regarding Baumann's stunt instruction might convey the impression that the 60 h.p. Gnome-engined Caudron biplane is not fitted with dual controls. I fancy I have mentioned before that this machine is fitted with the double control, but to make sure in case there are others in doubt, I would specially state that this mount *is* fitted with dual control. When instructing Baumann only gets up from his seat and leans over the pupil when the latter makes the same mistake repeatedly, so as to point out the error in a more forcible way than he could do by operating the controls in front of his own seat.

× × ×

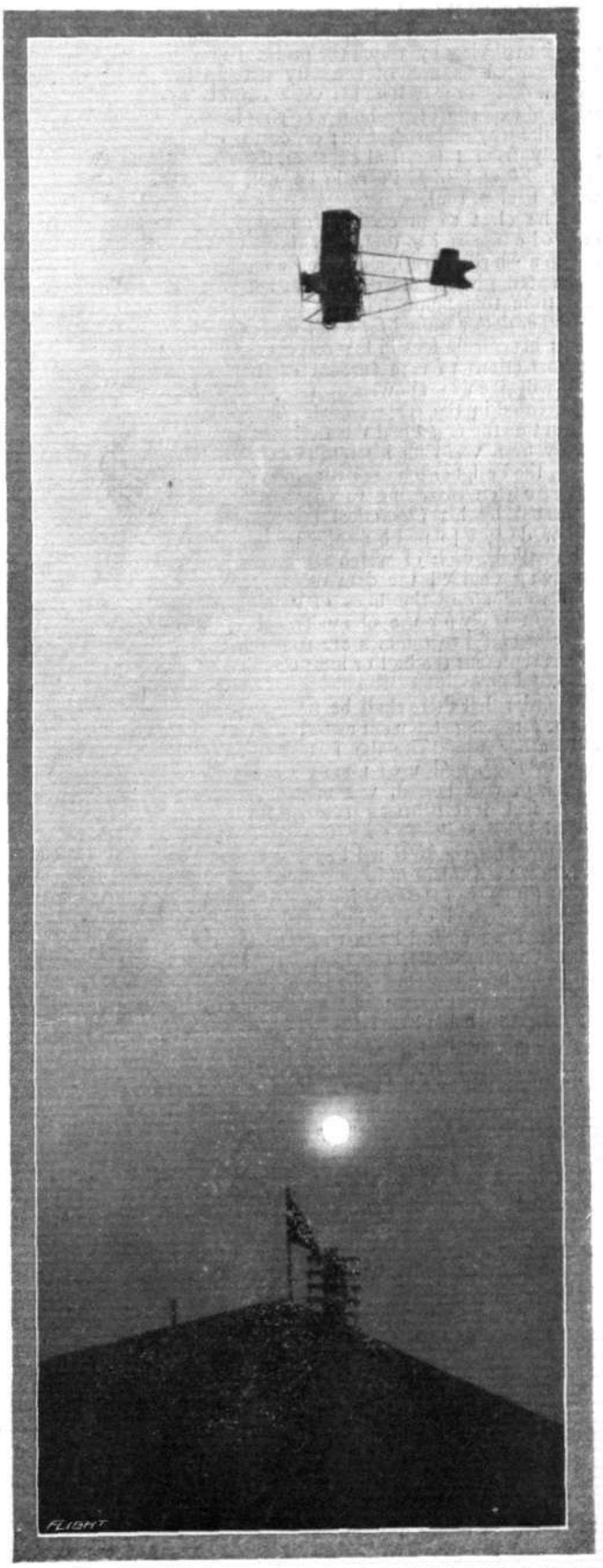
One hears all sorts of yarns about the doings of pilots at the front, some of which have to be discredited at once as purely imaginative, whilst of others it may be said that they "might have happened." In the latter category must be included one that was told me recently regarding M. Chevillard, who, it may be recalled, was taken prisoner by the Germans fairly early in the war. Chevillard, so the story goes, was not brought down by the enemy's fire (and knowing the erratic evolutions of which he was capable, I can imagine that he would have presented anything but an easy target), but was surprised whilst engaged in collecting a few souvenirs in the shape of German helmets in a field in which he had descended! Ah, well, it "might have happened."

× × ×

Under the heading "Generous Gift by an Englishman," the *Japan Gazette*, of January 27th, gives the following interesting item of news:—"It will be recalled that a certain foreigner, who chose to be anonymous, contributed to the Imperial Aviation Association Yen 20,000 in December, 1913, and Yen 156,000 in negotiable securities in July last, with a view to assisting the development of aviation among the Japanese. The foreigner in question has again signified to the Association, through Viscount Chinda, Japanese Ambassador in Washington, his intention of contributing another Yen 44,000 in negotiable instruments.

"According to the *Asahi*, this munificent donor, who wished to remain anonymous, is Mr. Robert T. Anderson, a British subject born in America. Beyond the fact that he is a business man, who has his home in London and his office in New York, everything is kept secret in compliance with his request. It is reported that he visited Japan several years ago with the *Cleveland* tourists. The Imperial Aviation Association immediately sent a reply through the Japanese Ambassador, expressing high appreciation of the donation."

The friend who sent along the cutting reminds me that part of the Yen 156,000 mentioned was to have been offered in prizes for a military engine competition, and the rest was to be given to the first airman to make a non-stop flight between Osaka and Tokio. "ÆOLUS."



"Flight" Copyright.

AT EVENTIDE.—An advanced pupil of the London and Provincial School flying at sunset at Hendon.

FLIGHT

MARCH 12, 1915.

THE FLYING MACHINE: THE AEROFOIL IN THE LIGHT OF THEORY AND EXPERIMENT.*

By F. W. LANCHESTER, M.Inst.C.E.

Introduction.—The design of the wing member, or aerofoil, of a flying machine, may be based either on the theoretical consideration of the function it has to perform, or alternatively on the ascertained results of scale model or full scale experiments. These two methods or points of view by which the problem may be approached are to be regarded as not of necessity overlapping; thus, on the one hand a designer may base his work entirely and absolutely on the result of experiment, without worrying himself in the least degree as to the why and wherefore; or, on the other hand, he may work entirely from theoretical considerations and produce an aerofoil whose lift and lift/drift ratio he will know within certain limits without actual trial.

If he elect to proceed on an empirical basis, he observes or otherwise ascertains that, submitted to trial in a wind channel (or on a whirling arm), a certain aerofoil model at a certain angle and speed gives some definite lifting reaction and lift/drift ratio, and from this figure he may determine the area and calculate the other data required for a full scale aerofoil to lift the required load; his calculations in this respect are based on the V^2 law and on corrections to take account of the laws of dynamic similarity, and will include allowances for structural members, &c., not represented in the scale model. There is, of course, nothing to prevent on the one hand the designer who is working from pure theory from verifying his results experimentally, or, on the other hand, the designer who is basing his work on scale model experiment from endeavouring to effect such improvements as may be suggested by his theoretical knowledge. The point which the author desires to make at the present juncture is that there are two methods, each of which is, within reasonable limits, capable of giving unaided the data required; generally speaking, those who work along the lines of empiricism appear not to make a sufficient study or use of modern theoretical knowledge, and so experimental programmes are sometimes drawn up which by no means represent the best or most economical means of reading the truth.

In order that there shall be no misapprehension as to the truth of the foregoing statement as to the present-day neglect of theory, the author would cite the fact that an aerofoil constructed by him in 1894, and used almost exclusively for his experimental models of that period, was mainly designed on the basis of the theoretical investigations subsequently published in his work "Aerial Flight." The aerofoil in question, tested with modern appliances (at the National Physical Laboratory and at Göttingen), has shown a lift/drift ratio of somewhat better than 17 : 1, which to-day (in spite of the experimental work that has since been done in the wind channels of the National Physical Laboratory at Teddington, the Aeronautical Laboratory at Göttingen, in Germany, and in the Laboratory of Mr. Eiffel, in Paris) stands as a record which has not so far been beaten. The author gives this fact at the outset by way of negative encouragement (and by way of a challenge) to those who affect to believe that direct experiment is the only method by which problems in aeronautics can be successfully tackled. The modern tendency has been to establish data for each and every trial form of aerofoil by wind channel experiment, and to search more or less empirically for forms which show better results than those already obtained. In many respects, the author is of opinion that the theoretical methods and lines of reasoning commonly followed in the work in question are at fault, especially when it is sought to assign independent values to the upper and lower containing surfaces of the foil, or when, for example, the question of aspect ratio is studied apart from that of camber. On the other hand, it must be remembered that the questions that enter into an investigation are highly complex. There are factors of importance, such, for example, as those which tend to permit of flying over the greatest possible range of speed (rather than those which conduce to economy at some particular speed); also such questions as position of centre of pressure—variations of centre of pressure with change of attitude—these are points in which purely empirical methods may turn out to be justified by results.

The empirical method, in brief, is to take some form—we may say any form—of aerofoil, and ascertain its behaviour, namely, its pressure constants, &c., in the wind channel or on the arm of a whirling table. The early experimenters, as Hutton, Vince, Dines and Langley, confined their attention mainly to actual *planes*, that is to say, to aerofoils of flat form, in which the main variants were angle and the proportion of breadth to length (fore and aft)—in modern phraseology, the *aspect ratio*. More recent experiments of a similar character have been carried out by the National Physical Laboratory in this country and by Mr. Eiffel in Paris, aerofoils of wing-like or pterygoid section having been investigated in addition to planes, some of the said sections being based on the aerofoils of actual machines of well-known type; others were expressly devised with a view either to demonstrating some particular point, or to obtaining improved results in one direction or another.

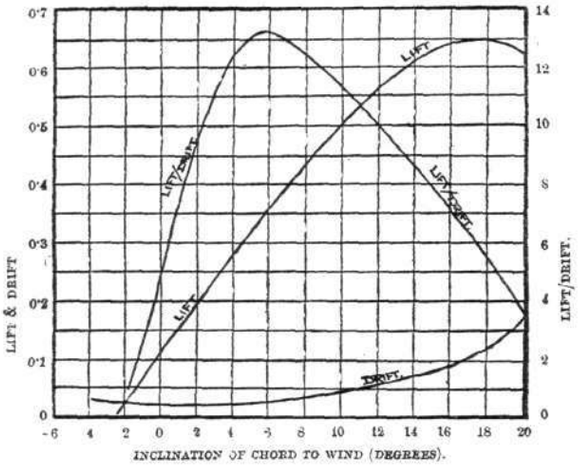


Fig. 1.

In its essence, the empirical method is an entirely simple matter. The subject of experiment, the aerofoil, is mounted in such a way as to permit of the lifting component and resistance component, commonly called for short *lift* and *drift*, for variations of *attitude*, which is the technical name by which the angle of attack is defined, the results obtained being tabulated or plotted as graphs. A plotting may, for example, be given as a graph in which the angle of attitude is denoted as abscissa, and the lift or drift, or other function of the angle, is shown as ordinate, each different form of plane or aerofoil, or different aspect ratio, being plotted as a separate curve. Examples of this method of plotting are given in Fig. 1. According to another method of plotting, the total reaction is plotted as a vector quantity, the magnitude of the lift and drift being obtained by an ordinary parallelogram of forces as co-ordinates, Fig. 2. According to this method, the angle of attitude of the plane appears to an irregular scale on the graph itself. Briefly, the method shown in Fig. 1 is the most generally serviceable where exact information is wanted such as round about the region of least resistance, or greatest lift, whereas the polar method (Fig. 2) has some advantage as being a *multum in parvo* by which the whole properties of an aerofoil from zero angle to 90 degrees may be represented in a compact form; if desired, the locus of the centre of pressure may conveniently be indicated on the same diagram. This method is that mainly used by Mr. Eiffel in the publication of his works. The National Physical Laboratory results, as given in the Reports of the Advisory Committee for Aeronautics, are, for the reasons stated, usually in the form shown

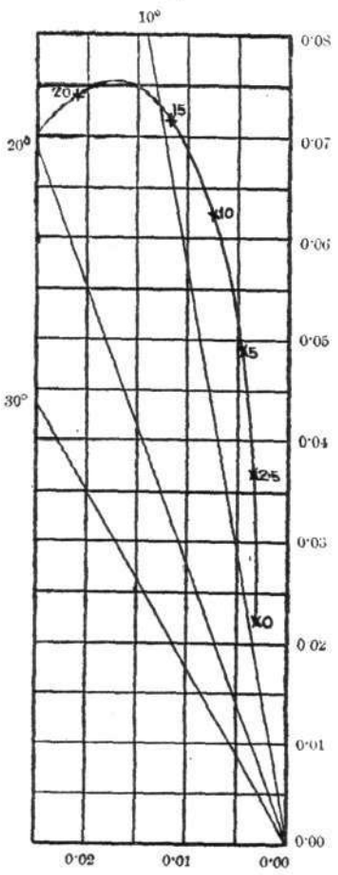


Fig. 2.

* Paper read before the Institution of Automobile Engineers on March 10th.

in Fig. 1. This, penerally speaking, also is the method more commonly adopted.

From our standpoint as engineers, the empirical method reduces the matter to its utmost simplicity. We leave the onus of the experimental work to the Aeronautical Laboratory, and we take "ready made," for the purposes of construction, a form defined in advance, and we see at once from the graph for each angle of attack exactly what speed is necessary to sustentation and what resistance we have to face. We have the means of calculating from the *v-square* law the angle of attack necessary for the carrying of any given load at stated velocity. We do not concern ourselves at all with theoretical questions of the form of the air flow round the aerofoil, but accept established experiment and make full use of it, just as the designer of a steamship may take without question a known form either for which experience has already given the necessary data or which has been experimentally investigated by means of a wax model in an experimental tank. For the commercial constructor of aeroplanes the above may be deemed sufficient, but it is not a progressive method: as engineers we cannot (at present at least) afford to relinquish entirely the theoretical study of aerofoil design. Given the necessary apparatus, working empirically without real theoretical understanding, it is always possible to accomplish a great deal, but it is evident that results cannot be achieved in this way either in a minimum of time or at least cost, and if in these respects experimental efficiency is being considered, it is necessary to have some sound and satisfactory theoretical basis on which to work.

By a sound and satisfactory basis, the author does not mean of necessity a complete treatment or method based, like electrical theory, on the exact concepts of the mathematician, but rather a theory whose fundamental ideas are in accordance with the facts of the problem, in the main qualitatively right and capable of pointing the direction, even if not always adequate to measuring the distance. A theory which is properly founded does not require to be quantitatively complete in order to constitute an adequate guide to experimental investigation.

§ 1. *The Theory of Sustentation based on Vortex Motion.*—The foundation of the theory of sustentation in flight, and of the supporting member, the aerofoil, is, as laid down in the author's "Aerodynamics," properly to be sought in the study of the vortex system set up in the air by the distribution of pressure on the aerofoil in motion as constituting the reaction by which the load is sustained; it has, however, proved difficult to attack the problem of sustentation directly from our knowledge of vortex theory.

The author is not acquainted with any method giving results which accord even approximately with experiment other than his own, which is, in effect, an application and extension of the Newtonian method as applied by Rankine and Froude to the theory of marine propulsion, resting directly on the third law of motion. The method in question involves that which has been sometimes termed the doctrine of the *continuous communication of momentum*; the fundamental equation involved is that the force sustained by the fluid reaction is numerically equivalent to the momentum communicated per second to the fluid; in the case of the aeronautical problem, the air.

In the author's work it is shown that the immediate application of this method does not lead to conclusions which accord with experience; by the aid, however, of certain auxiliary concepts introduced into the theory as based on a study of vortex motion, he has found it possible to frame a *régime* in connection with which the Newtonian method can be made to give data which, in spite of the *apparent* looseness of method, are in remarkably close accord with the results of experiment. The first step, therefore, in the preliminary consideration of the subject is the detailed study, from the point of view of vortex theory, of the motions generated in the air by the aerofoil as due to its function in sustaining the load, and which otherwise accompany and surround the aerofoil in its flight.

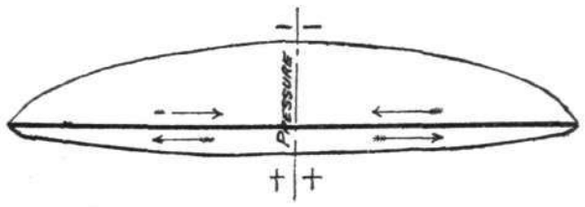


Fig. 3.

§ 2. *The Distribution of Pressure on the Aerofoil and its Consequence.*—We will now examine the pressure distribution of an aerofoil as we know it by experiment to exist;* in Fig. 3 it is presumed that we are viewing the aerofoil along (in the direction of) the axis of flight. Now, it is an experimental fact that in any ordinary design of aerofoil, such as used in actual construction, the pressure difference is maximum in the central region and tails off towards the extremities, and that this applies both to the positive pressure below and the negative pressure, or suction, above; the question of the relation of the pressure to the suction has no immediate bearing on the present argument. A result of this distribution of pressure is that any small unit mass of air passing beneath the aerofoil receives (in addition to downward acceleration) an acceleration component outwardly towards the aerofoil extremities, as shown in the figure by the arrows. Likewise, air passing above the foil receives an acceleration inwards towards the central region, since the vacuum there is greatest; thus, looking at the aerofoil in plan, Fig. 4, we see that the path of the air stream passing over the aerofoil is convergent, as shown by solid lines, and the air passing under the foil is divergent, as shown by the dotted lines, the curvature of the path in the immediate vicinity to the

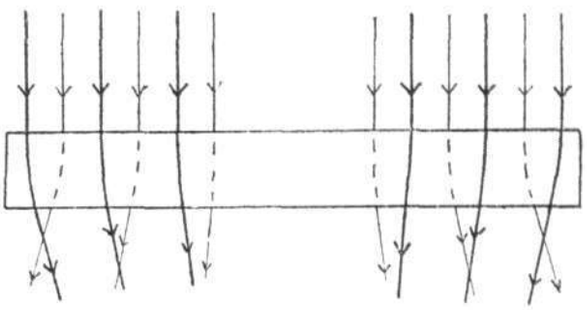


Fig. 4.

aerofoil being an indication of the acceleration applied. When the two adjacent layers of air, one from the upper service and the other from the lower surface, rejoin at the after edge of the aerofoil, they are thus found to have relative motion impressed upon them, as already given by the arrows in Fig. 3. Now this condition denotes that there is a surface (or stratum) of discontinuity existing in the track of the aerofoil behind the right and left hand wings, otherwise known as a vortex sheet (the *surface of gyration* of Helmholtz), the air forming which contains rotation. We also know that such a vortex sheet or stratum rapidly splits up into a number of vortex filaments belonging to a common vortex system involving the surrounding fluid. That this phenomenon is no purely local manifestation becomes quite evident when we consider the fact that the pressure region under each aerofoil wing and partial vacuum above it give rise everywhere to the air in the vicinity of a circulatory movement, as indicated in

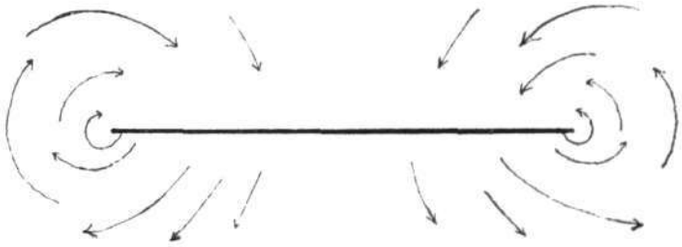


Fig. 5.

Fig. 5, the said circulatory motion being superposed, from the point of view of an observer moving with the machine, on the motion of translation.

The whole of the foregoing is deduced in the author's "Aerodynamics," apart from any experimental evidence such as taken here as the basis, the motions being there depicted more particularly in Figs. 83, 85, 86. Thus, the disturbance left in the wake of an advancing aerofoil consists of two equal and opposite vortices—a vortex pair in fact—whose "core" consists of a number of distributed vortex filaments all bound up in the common cyclic motion, in accordance with well-established principles, having a downward precession, the movement of each vortex trunk as a

* The author finds here the option of approaching the present subject either in the manner of treatment already adopted in his "Aerodynamics," that is to say by a process of cold-blooded deduction with the least possible assumption as to experimental fact, or to deal, as he is here doing, with certain experimentally ascertained facts, as involving of necessity certain consequences in the behaviour of the air.

whole being that proper to the motion of its fellow: it will be demonstrated that *it is the reaction due to the continuous production of this vortex pair which is the eventual source of sustentation in flight.*

§ 3. *Independent Evidences of the Trailing Vortex Pair.*—Before dealing with the whole consequences which follow from the established existence of this vortex pair, certain comments will not be out of place as to the independent evidences, such as they are, for the existence of these vortices, and some of the indications that the designer of the aerofoil may gather by taking them into account.

Firstly, it is not difficult by passing an inclined plane through air charged with smoke to see with one's own eyes the vortex motion produced. Secondly, the extent of the "wash" left behind by the aerofoil, and acting on the tail member behind it, can be roughly computed on the basis of this residuary vortex motion (Appendix I). Thirdly, as stated in the author's "Aerodynamics" (p. 174, Fig. 80), if an inclined plane be moved under water in the vicinity of the surface, indications of vortex motion are found in the dimples which can be seen in the vicinity of the wing terminations.

To the designer, the immediate importance of considering the function of the aerofoil in producing these trailing vortices lies in his realisation of the need for the pressure diminution towards the aerofoil extremities; manifestly, if the pressure is carried too uniformly into the terminal regions, the rotational core of the vortices will be concentrated, and the energy left behind in the vortices themselves becomes disproportionately great; that is to say, the motion will tend to become a strong local vortex at the wing extremities containing great energy, instead of being more diffuse and consequently more economical. Probably, there is yet considerable work to be done in the direction of improvement from this point of view.

§ 4. *The Cyclic Component in the Motion around the Aerofoil.*—We will now pass on to consider a very important consequence of the vortex theory of sustentation. It may be taken that it is impossible that two vortices of opposite hand should be attached, or attach themselves, to any material body without the vortex motion extending continuously around the body from one to the other. From the strict standpoint of hydrodynamic theory, we know that before cyclic motion can be regarded as possible, the region involved must be *doubly* or *multiply connected*, and we know that in the case of an aerofoil (under actual conditions in three dimensions) this condition is not complied with. But we also know perfectly well that in the real fluid the conditions of double connectivity can be and are *simulated*, in so far as the central bar to connectivity is concerned, by a filament or column of fluid in rotation. In some cases this filament or column forms a complete loop as in the ordinary smoke ring; in other cases its extremities attach to some boundary surface, such as the earth or sea in the case of a whirlwind or waterspout, or to the surface of the water (from beneath) in the case of the half vortex hoops which are generated by a stroke of a paddle in water. The greatest difficulty that presents itself is the case of vortices trailing away indefinitely into the distant air (or water) without apparently any direct boundary connection, as in the case of the lateral vortices we have been considering; probably it will be found when the theory of the real fluid is sufficiently understood that this condition is dynamically possible, and is in some way related to a rate of decay or degeneration; in any case, it is definitely a condition which we know exists if only from optical demonstration, hence even if we cannot for the time being satisfy ourselves as to the theoretical aspect of the subject, we must at least be prepared to swallow it as a fact. (Appendix II.)

Thus each of the lateral trailing vortices has one of its extremities dying away in the distant air astern, where its motion is undergoing decay, and its other extremity, its forward end, attached to the aerofoil, where it is continuously being renewed; thus, the aerofoil forms, as it were, a bridge connecting two vortices which (viewed from their points of attachment) are of opposite hand. Now it is quite clear when we view the aerofoil and vortex system as a whole, that the interruption in the simple connectivity of the region introduced by the rotation in the vortex cores is maintained between them by this bridge, *i.e.*, by the aerofoil itself, and moreover that the vortex trunks on the two flanks are really part of a single system whose cyclic component surrounds the aerofoil in at least the same strength as it exists at the region of attachment, Fig. 6. The validity of this view can scarcely be disputed; the sudden termination of the vortices at the wing extremities would be quite inconsistent with hydrodynamic theory. Beyond this, all the analogies which are known to exist between electro-magnetic and hydrodynamic theory point in the same direction; a line of magnetic force, for instance, passing through a particle of iron is not and cannot be regarded as two separate lines terminating on the surface of the iron and unconnected—they are part of a continuous unit.

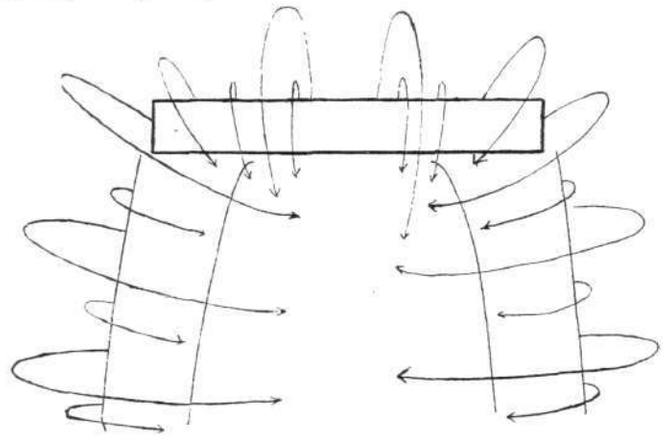


Fig. 6.

Or again, the continuity of lines of electrical stress, which results in the law founded on Faraday's "ice-pail" experiment. Thus, the author regards the two trailed vortices as a definite proof of the existence of a cyclic component of equal strength in the motion surrounding the aerofoil itself.

(*To be continued.*)

AIRCRAFT AND THE WAR.

IN the "wireless" news sent out from Berlin on the 3rd inst. there was the following:—

"At Peronne, a French flying machine descended on account of a defect in the motor. The occupants were taken prisoners."

In a message from the Athens correspondent of the *Messaggero* on the 3rd inst. dealing with the bombardment by the French of the Bulair lines, it was stated:—

"The two Turkish aeroplanes which were sighted quickly disappeared when pursued by the Allies' airmen."

In a message from the Turkish headquarters, received in Amsterdam on the 3rd inst., it was stated:—

"Our aviators successfully bombarded the enemy ships at Ivak."

Other reports received from Athens state that the bombardment on the 3rd inst. took place in a fog which rendered it impossible for the aviators to ascertain what damage had been done.

Writing to the *Daily Telegraph* on the 4th inst. from Basle, Mr. A. Beaumont said:—

"Two days ago the weather cleared up in many parts of the Vosges, and renewed activity has been observed on the part of the belligerents on both sides. No less than six aeroplanes could be seen at one time flying over the German lines in the valley of the Large, between the town of Pfetterhausen and Altkirch, and the guns on both sides kept up an uninterupted fire all day. . . . .

"A German captive balloon appeared for a moment, but immediately afterwards two French aeroplanes were circling over it, and the balloon was rapidly taken down."

It was reported that the L 8 was wrecked on the 4th inst. at 11 p.m. near Tirlemont, and the following details were obtained by a correspondent of the Dutch *Telegraaf*:—

"Two Zeppelins passed over Tirlemont, and it was clear that the engines of one were not working satisfactorily, as a series of loud reports could be heard. At 3 a.m. L 8 descended rapidly in a field near Wommerson, smashing seven poplar trees. The airship was badly damaged and one of the gondolas was driven into the ground to a depth of 6ft., while the frame was broken in the middle. As the ballonets fore and aft were still inflated the airship took the form of a V. Several of the crew were killed and were buried the same morning near the scene of the accident. The airship became

a total wreck, and the frame and silk cover were taken away in motor wagons. Four hours after the accident all traces of it had gone. The correspondent says that the Zeppelin was wrecked beyond repair."

According to a telegram from Basle on the 6th inst., six French airman passed over the German village of St. Ludwig, proceeding in the direction of Wiesenthal. They were fired upon by German soldiers, but were not hit.

In a *communique* issued in Constantinople on the 6th inst., it was stated :—

"Two airmen who flew across the Gulf of Saros fell into the sea, and their seaplane disappeared in the water."

A subsequent *communique* stated :—

"It is confirmed that the hostile aeroplane which fell into the sea was brought down by the fire of our batteries."

A *Daily Chronicle* correspondent, writing from N.E. France on Saturday, said :—

"According to the report of an eye-witness, a Zeppelin which appeared over the French lines near Bethune on Wednesday was brought down and captured. Several French and English airmen went in pursuit of the airship as soon as it appeared, climbed above it, and dropped bombs which penetrated the envelope. The hinder part of the balloon was seen to break away from the rest, and the Zeppelin rapidly fell to the ground in a collapsed condition. The Zeppelin which passed over Calais on Thursday night followed the coast westwards as far as Ambleteuse—some four mlles north of Boulogne—where it was seen shortly before midnight. It then turned back."

A *Daily Mail* correspondent in Northern France, writing on Saturday, said :—

"A Zeppelin visited Dunkirk on Thursday night at about 7.30, flying over the town in the direction of Calais. It was immediately fired on by the forts and anti-aircraft guns.

"The wind, which had been blowing only lightly during the day, increased after sunset. This compelled the Zeppelin to return without accomplishing its mission. No bombs were dropped.

"At 4.30 yesterday afternoon a Taube flew over Dunkirk, and after circling over the town beat a hasty retreat on being chased by Allied airmen. No damage was done."

Writing to the *Daily Chronicle* on Saturday a Geneva correspondent said :—

"A report from Friedrichshafen states that Count Zeppelin has arrived to hurry forward the building of two Zeppelins.

"It is confirmed that during a fierce storm at Cologne the Zeppelin sheds in that city were blown away. One airship was destroyed, another was badly damaged, and several soldiers were injured."

A *Morning Post* correspondent at Amsterdam reported the following on March 7th :—

"For the first time German aviators on February 26th threw bombs on La Panne, on the coast between Dunkirk and Ostend, two soldiers being killed and a civilian, aged 80."

In a description of a visit to the General Headquarters of the British Expeditionary Force in Northern France, the special correspondent of the *Daily Mail* said :—

"The programme arranged for us began with a visit to the aviation park, within a short motor-car ride of the town. At this point the air patrol service is centred and controlled. A record is kept of every flight and its success or non-success, that is, whether information was obtained and proved to be correct, carefully tabulated for reference. Every aeroplane is tended by two mechanics, one for the engine and one for the planes and frame. The result of all this care is the gratifying small proportion of accidents among the Army airmen.

"A walk across muddy fields brings one to the quarters of the wireless aeroplane section. This section, divided into flights of four machines each, consists of aeroplanes fitted with wireless telegraphic apparatus capable of transmitting signals to the receiving station at the aviation park. It has been found possible, as the result of a wireless signal from the air, for the artillery to locate and hit a moving target before it could reach shelter."

Dealing with a visit to the British General Headquarters in a message to the *Daily Telegraph*, written on Sunday, Mr. E. Ashmead-Bartlett said :—

"The batteries are, of course, a considerable distance behind the trenches of both armies, and the gunner never sees what target he is aiming at. The artillery officers engaged in observation use every conceivable expedient to obtain a view of the effect of their shell fire, but much of the shooting can only be observed and corrected by aerial reconnaissance.

"The aeroplanes of both armies are continually engaged in flying over the lines and observing the position of the enemy's batteries, of his troops, munition trains, and marking all the likely farms and villages where brigade headquarters or battalion billets are likely to be. The large scale map of this country, which has had to be gradually made from smaller maps already in existence, is divided into small squares, each numbered. The aviator marks on his map the position of some battery or farm, and on his return communicates with the battery commander in this section of the line. The latter marks his map in turn, and then works out to the minutest fraction the distances and angles of fire, all of which are carefully entered in a book. The batteries then register each new target suggested to them by the aviator. That is to say, they fire a certain number of shots, the results of which are noted by the aviator, who corrects the aim by signal, or on his return to earth.

"Headquarters of brigades are being continually changed, and batteries are continually being shifted. The aviator has to do his utmost to keep in touch with all such changes. In addition, both armies conceal their batteries so carefully that it is often quite impossible to discover them from above. But in spite of the most careful observation, numerous points seem to escape the notice of the enemy, without any apparent reason, or else the guns never find the right range."

In the "wireless" news sent out from Berlin on Monday there was the following :—

"In the Western theatre of war hostile airmen bombarded Ostend."

The following report of the wreck of another Zeppelin was sent by the Boulogne correspondent of the *Daily Telegraph* on Monday :—

"My correspondent wires the following, with all reserve :—

"From reports received here this morning I am given to understand that the captain of a Danish steamer sighted a Zeppelin floating on the sea. Close examination revealed it to bear the figures L 9. The wreck was seen about twenty miles north of Wimereux Bay (three miles from Boulogne port). This may be explained by the fact that for the last few days three Zeppelins have been sighted between here and Calais manœuvring above the sea. Probably one of these met its fate in last night's hurricane that blew all along this coast."

The following details regarding life at Ostend at the present time were published in the *Tyd* on Wednesday, having been sent by its Sluis correspondent :—

"Conditions at Ostend are becoming worse daily, owing to the repeated raids made by the Allied aviators. The harbour station, after three air raids, is still standing, though slightly damaged. The reason for the repeated air attacks, according to the correspondent, is that Ostend is used as a submarine base, and the station as barracks for marines.

"The Hotel La Couronne, where high officers used to stay, has been closed, as in the immediate neighbourhood many bombs have been dropped, which destroyed part of the bridge near the hotel. Some villas on the boulevard have also been damaged. The population have been forbidden to leave the town or enter the prohibited area near military places. The bridges are strongly guarded."

A Derelict Waterplane in the North Sea.

THE following message was sent from Amsterdam by a *Daily Mail* correspondent on the 4th inst. :—

"A Dutch pilot boat last night discovered a wrecked waterplane in the North Sea. It was brought to Ymuiden Harbour to-day by torpedo-boats.

"The wings and framework of the waterplane were badly damaged. The motor was made in the Gnome works of the Société des Moteurs, Paris, but the propeller was marked 'No. 287 R,' and the word 'Shotter' was painted on the wood. The waterplane was provided with English compasses and three English manometers, and also a clock, which had stopped at ten minutes to five."

Models

Edited by V. E. JOHNSON, M.A.

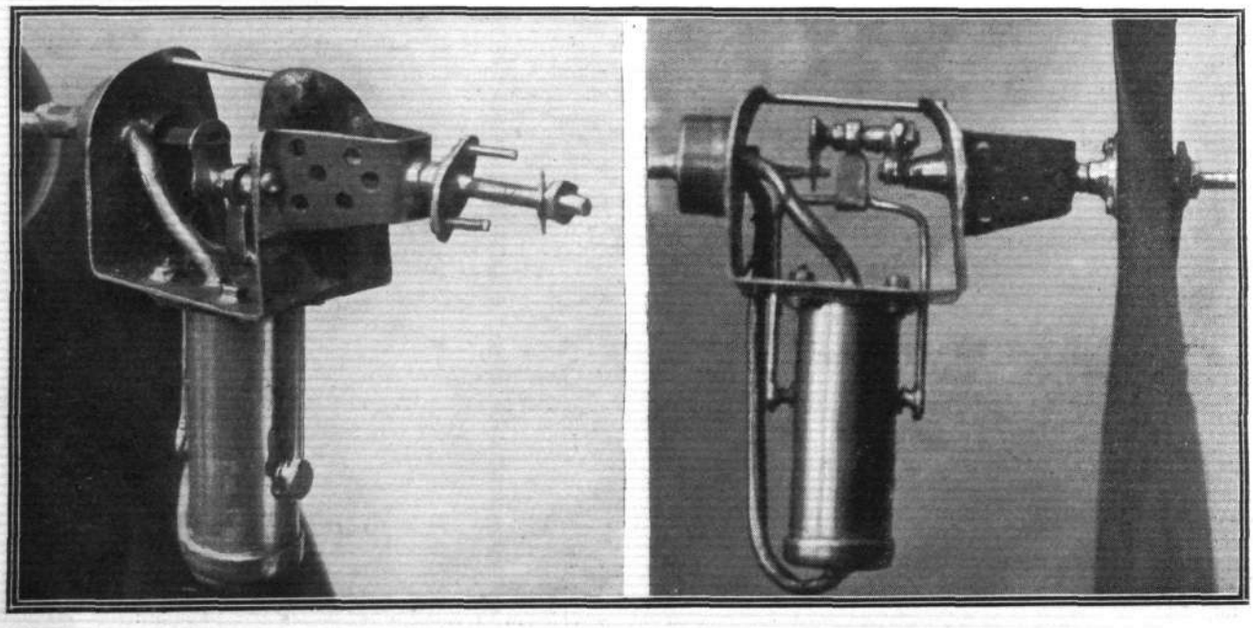
Professor Langley's Model Work.

(*Continued from page* 167.)

"THE first steam-driven model had, then, proved a failure, and I reverted during the remainder of the year to simpler plans, among them one of an elementary gasoline engine ; I may mention that I was favoured with an invitation from Mr. Maxim to see his great flying machine at Bexley, in Kent, where I was greatly impressed in the great engineering skill shown in its construction, but I found the general design incompatible with the conclusions I had reached by experiments with small models, particularly as to what seemed to me advisable in the carrying of the centre of gravity as high as was possible with safety. [This last statement is of great interest, since it clearly shows that Professor Langley had learnt *from experiments with small models* that a low centre of gravity was wrong, a fact which has since been confirmed over and over again]. In 1892 another model (No. 1), in which either carbonic acid gas or compressed air was to be the motive power, was commenced. The weight of this model was 4·5 lbs., and the area of the supporting surfaces 6·5 sq. ft. The engines developed but a small fraction of a horse power, and they were able to give a lift of only about $\frac{1}{10}$ *the total weight of the model, giving relatively less power* to weight than that obtained in the large model already condemned. Toward the close of this year was taken up the more careful study of the position of the centre of gravity with reference to the line of thrust from the propellers, and to the centre of pressure. The centre of gravity was carried as high as was consistent with safety, the propellers being placed so high with reference to the supporting wings, that the intake of air was partly from above and partly from below these latter. The lifting power (*i.e.*, the dead lift) of the model was determined in the shop by a very useful contrivance which I have called the 'pendulum,' which consists of a large pendulum which rests on knife-edges, but is prolonged above the points of support and counterbalanced so as to present a condition of indifferent equilibrium. Near the lower end of this pendulum the model was suspended, and when power is applied to it, the reaction of the propellers lifts the pendulum through a certain angle. If the line of thrust passes through the centre of gravity, it will be seen that the sine of this angle will be the fraction of the weight lifted, and thus the dead lift power of the engines becomes known. Another model was built, but both, however, were shown by this pendulum test to have insufficient power, and the year closed with disappointment.

"Model No. 3 was of stronger and better construction, and the propellers, which before this had been mounted on shafts inclined to each other in a V-like form, were replaced by parallel ones. Boilers of the Serpolet type (that is, composed of tubes of nearly capillary section) were experimented with at great cost of labour and no results, and they were replaced with coil boilers. For these I introduced, in April, 1893, a modification of the aelopile blast, which enormously increased the heat-giving power of the fuel (which was still alcohol), and with this blast the boilers at last began to give steam enough for the engines. It had been very difficult to introduce force pumps which would work effectively on the small scale involved, and after many attempts to dispense with their use by other devices, the acquisition of a sufficiently strong pump was found to be necessary in spite of its weight, but it was only secured after long experiment. It may be added that all the models from the very nature of their construction were very wasteful of heat, the industrial efficiency little exceeding half of one per cent. or from $\frac{1}{10}$ to $\frac{1}{20}$ that of a stationary engine constructed under favourable conditions. The last model lifted nearly 30 per cent. of its weight on the pendulum, which implied that it would lift much more when running on a horizontal track, and its engines were capable of running its 50 centimetre propellers at about 700 r.p.m. There was, however, so much that was unsatisfactory about it that it was deemed best to proceed to another construction before an actual trial was made in the field, and a new model, designated No. 4, was begun. This last was an attempt, guided by the weary experience of preceding failures, to construct one whose engines should run at a much higher pressure than heretofore, and be much more economical in weight. The experiments with the Serpolet boilers having been discontinued, the boiler was made with a continuous helix of copper tubing, which, as first used, was about 3 millimetres internal diameter, and it may be here observed that a great deal of time was subsequently lost in trying to construct a more advantageous type of boiler for the actual purpose than this simple one, which, with a large coil tube, proved to be the best, so that later constructions have gone back to this earlier type. A great deal of time was lost in these experiments from my own unfamiliarity with steam engineering, but it may also be said that there was little help to be had either from books or counsel, for everything was here *sui generis*, and had to be worked out from the beginning. In the construction which had been reached by the third year of experiment, and which has not been greatly altered, the boiler was composed of a coil of copper [steel would, of course, have been much better] in the shape of a hollow helix, through the centre of which the blast from the aelopile [*i.e.*, the blow lamp] was driven, the steam and water passing into a vessel called the "separator," whence the steam was led into the engines at a pressure of from 70 to 100 lbs., a pressure which has since been considerably exceeded."

(*To be continued.*)



Mr. D. A. Pavely's compressed-air motor, as seen from a three-quarter end view and side view.

Mr. D. A. Pavely's Compressed-Air Engine.

"Seeing the interest that is now being taken in compressed-air plants, I thought I would write and let you know that I have designed and constructed an engine which I think is original. It is a double-acting single cylinder engine, but has no stuffing box. I have no time to write a description, but if the same is of interest, I shall be glad to send it on to you to examine." Further, in answer to our reply, Mr. Pavely says: "I enclose engine herewith; you will notice that it is on the heavy side, but I made it really to see how the double-acting idea worked, and therefore I did not take much trouble either about weight or finish. I should be glad if you would test the engine under pressure."

The general idea of the motor—which, so far as we know, has some decidedly original features—can, we think, be gathered from the two photographs. The cylinder, the wall of which is of steel, is $1\frac{7}{8}$ ins. in length and $\frac{3}{4}$ in. external diameter; its ends are of brass; to the upper end is bolted the thin brass framework carrying the bearings, &c.; to this frame is also soldered on the left the rotary valve; from the valve chest two delivery tubes are carried, one to the upper end of the cylinder and one to the lower. On each side of the piston, exactly opposite one another, and equidistant from either end, is cut a rectangular slot, a little more than $\frac{1}{16}$ in. wide and about $\frac{5}{8}$ of an inch long, being approximately the length of the piston stroke. The opposite ends of the two pistons are about $\frac{1}{4}$ of an inch apart, this representing the length of the piston apparently. The connecting rod or rods, for there are two, one on each side of the cylinder, being connected with the very short piston-rod midway *between* the two piston ends. It will be seen that this ingenious method enables you to obtain a very *compact* engine, because it enables the crank and propeller axle, and also the rotary valve, to be very near the end of the cylinder. The total weight of the engine is $3\frac{3}{4}$ ozs., but, as Mr. Pavely says, no attempt was made to keep down the weight, and this could be considerably reduced; in fact, the *compactness* of the motor, its chief feature in our opinion, should enable it to be built very light indeed, probably not much more than one-half its present weight, say 2 to $2\frac{1}{2}$ ozs. Tested under pressure the engine swung a 16-in. propeller round in fine style; the compression is quite good, well-oiled leather cup washers are apparently fitted to the piston, and the motor runs easily, and when some trouble is taken about carefully balancing it, smoothly as well. There also appears to be very little leakage indeed. Tested on a light load (a 12-in. propeller), the motor did not accelerate quite so much as we should have expected. It rather struck us (of course, we may be wrong in this respect) that the exhaust, especially at one end, was not quite adequate, and that was in consequence a retarding back pressure. This is a matter, however, which, if it exists, can easily be remedied.

We must congratulate Mr. Pavely on this new type of engine, which we think is well worth experimenting with. We should like to see one constructed with two cylinders, with the cranks so arranged as to give *four* impulses each revolution. We have had this objection urged against the double-acting single cylinder engine, viz., that it "knocks" badly, and we must confess that we have experienced this fault, but how much of it is due, not to the design of the engine, but to a proper want of balance.

Since the above was written we have seen a motor (not designed for model aeroplane work) which resembles Mr. Pavely's in many respects, but instead of having a rotary it has a slide valve fitted to one side of the cylinder, covering, as it were, one of the slots, of which there is only one through which the pin and connecting rod are carried. Of the two designs we must say Mr. Pavely's is much the neater.

The Scientifically Designed Model.

"I have noticed," writes Mr. O. Hamilton, Junior, "that there has been some correspondence upon the subject of the 'Scientific Model,' but I have carefully refrained from entering the discussion hurriedly, as I know I should only add something that would possibly make the topic argumentative.

"Your correspondent Mr. B. Rodger has submitted a detailed specification, which in my humble opinion has added something that when actually produced in model form will bring us nearer the ideal we are endeavouring to see and work upon.

"I do not think that there is anything that one can criticise in Mr. Rodger's specification, but I think that if anyone tried the development on these lines for experiment with elastic motors, the experimenter would have to consider the span of the plane, in considering his propellers, because it is a well-known fact that a model aerofoil has a very large drift and lift ratio.

"My opinions on the subject combined with the above correspondent and the views of Mr. Shepley-Part in the same issue are as follows:—

"1. That the span of the planes shall not be less than the length of the *fuselage*.

"2. That without exception aerofoils should be of double surface, except that in the case of biplanes, perhaps, it would be better to encase the ribs in pockets.

"3. That the aspect ratio of the planes shall not be less than four.

"4. That the angles of incidence of the main plane and elevator be in such a combination as to form a fore and aft dihedral for stability in the longitudinal direction.

"5. That for the purposes of lateral stability, the individual experimenter adopts what system he feels will have the best result.

"6. With Mr. Rodger I agree that all fins and rudders be equally placed on each side of the centre line of thrust of the machine.

"7. That the power plant be of the nature that will give the greatest efficiency and duration without unduly lengthening the dimensions of the *fuselage*.

"8. That all be designed to suit propellers within a fixed range of propeller pitch angle.

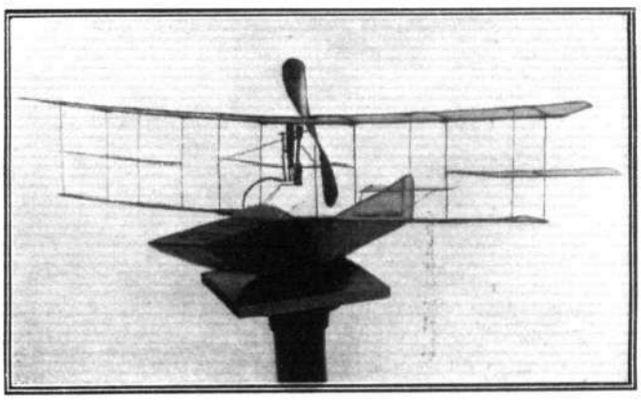
"9. That the machine be equipped with a chassis suitable for rising from an unprepared surface such as is usually found on most club grounds.

"10. That the model be fitted with rudders that can be mechanically operated during the flight, by the setting of a motion gear preparatory to flight."

The Williams Flying Boat Model.

Mr. S. Williams sends us the following interesting communication and photograph, reproduced herewith, of a flying boat model driven by a compressed air plant:—

"With respect to your paragraph in a recent issue, referring to a 'compressed air driven flying boat,' the enclosed photo. may be of interest to your readers; the model was actually built about a year ago. The model is of the Curtiss type. For various reasons I have not been able to carry out any experiments with it, but I certainly think there are possibilities in the idea. The hull, which has a step, is made of thin whitewood (cut out), and covered with painted silk, the container being enclosed in the fore part. The engine shown was for temporary use only."



The Williams flying boat model.

Reply to Query.

O. HAMILTON.—We shall be pleased to receive a copy of the club magazine and return the same as suggested.

⊛ ⊛

Double Fatality in France.

WHILE making a night flight over Chalons Camp one evening last week, a machine, in which were Lieut. Mouchard and Sapper Malliard, suddenly caught fire and fell to the ground. Both the occupants, who were well-known and experienced pilots, were killed instantly.

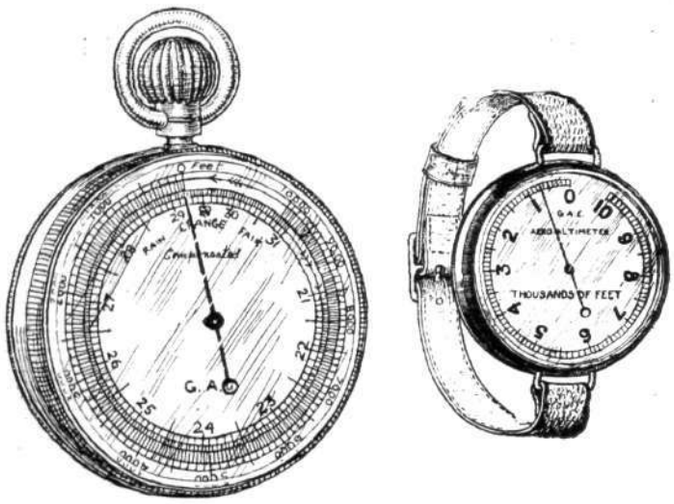
⊛ ⊛

Fatal Accident in South America.

A CABLE message received on the 2nd inst. announced that a military aviator named Ricardo Keik fell from a great height and was killed while carrying out a reconnaissance over a rebel camp in the State of Parana.

TWO NEW G.A.C. ALTIMETERS.

SINCE describing the G.A.C. "Featherweight" altimeter some little time back, the General Aeronautical Co., Ltd., of 30, Regent Street, London, W., have put on the market two new models that should prove to be as popular as the former ones have already become. Both are remarkably small and light, in spite of the fact that they give readings up to 10,000 ft. with a high degree of accuracy, and they should form most acceptable presents to any of our flying officers at the front. The one shown on the left of the illustration is model No. 7, a miniature pocket type having a combined altitude and barometric reading. The mechanism is enclosed in a strong aluminium case, and a keyless dial adjustment is provided. The diameter of the silvered dial is 1½ ins., and the instrument



weighs only 1¾ ozs. The price, complete with plush-lined leather case, is £3 3*s*.

The second instrument, model No. 8—known as the "Service"—is of the wristlet type; it is somewhat similar to No. 7, except that it has altimetric reading only, and that the dial is adjusted by rotating the glass frame. The silvered dial is clearly marked, similarly to the "Aeroplane" model, with divisions of 100 feet, numbered at the thousandth points in black up to 7,000, and red for 8,000 to 10,000. The reading can clearly be discerned at between two and three yards' distance. The total weight is 2 oz., and the dial, as in the case of No. 7, is 1½ ins. in diameter. The price, complete with a strong and neat leather strap for attaching to the wrist, is £3 17*s*. 6*d*.

⊛ ⊛ ⊛ ⊛

PUBLICATIONS RECEIVED.

The Clipper of the Clouds. By Jules Verne. London: Sampson Low, Marston, and Co., Ltd. Price 2*s*. 6*d*.

The Master of the World. By Jules Verne. London: Sampson Low, Marston, and Co., Ltd. Price 3*s*. 6*d*.

⊛ ⊛ ⊛ ⊛

NEW COMPANY REGISTERED.

Holmes' Marine Life Protection Assoc., Ltd., 8, Great Winchester Street, E.C.—Capital £3,000, in £1 shares. Acquiring business carried on at 8, Great Winchester Street, E.C., and elsewhere, as the Holmes' Marine Life Protection Association, manufacturers of lights, flares, topedo indicating lights, fog horns, lamps, life savers, pyrotechnics, rockets, signals, line throwers, life buoys, life belts, cork jackets and all kinds of apparatus, devices, or equipments for saving or protecting life on sea or land or in the air. First directors, T. Manwell and W. A. Manwell.

⊛ ⊛ ⊛ ⊛

IMPORTS AND EXPORTS, 1914–1915.

AEROPLANES, airships, balloons, and parts thereof (not shown separately before 1910). For 1910 and 1911 figures, see FLIGHT for January 25th, 1912; for 1912 and 1913, see FLIGHT for January 17th, 1914; and for 1914, see FLIGHT for January 15th, 1915:—

	Imports.		Exports.		Re-Exportation.	
	1914.	1915.	1914.	1915.	1914.	1915.
	£	£	£	£	£	£
January ...	5,945	20,382	210	435	879	13,706
February	28,132	380	106	138	441	18,823
	34,077	20,762	316	573	1,320	32,529

ENEMY PATENTS RELATING TO AERONAUTICS.

THE following list of British patents which have been granted in favour of residents of Germany, Austria, or Hungary, is furnished in view of the new Patents Acts, which empower the Board of Trade to grant licences under certain conditions to British subjects to manufacture under enemy patents, and is specially compiled for FLIGHT, by Lewis Wm. Goold, Chartered Patent Agent, Enrolled Patent Attorney in the United States, 5, Corporation Street, Birmingham. It is desirable in the first instance to obtain a full copy of the patent specification (price 6*d*. each patent), and also the latest particulars upon the Patents Register. If any patent listed has been assigned to a non-enemy proprietor, the law does not apply.

No. 18253/12. Balloon fabrics. Balloon and like envelopes are made up of strips with rhomboidal shaped pieces having diagonal warp threads, secured to them by adhesives and sewing. Siemens Schuckertwerke, Berlin.

No. 18338/12. Attaching ropes to fabrics. A draw-rope is attached to fabric surfaces, such as the envelopes of balloons or airships, by means of a loop passed around a grooved bit provided in the fold of a piece of fabric secured to the fabric surface, the stress being thus distributed uniformly over a large area of the surface. The bit may be made of wood, and its groove closed by a web. Siemens Schuckertwerke, Berlin.

No. 9930/12. Launching missiles from aerial machines. Relates to apparatus for dropping missiles from flying-machines which are provided with recesses for the reception of the missiles, and consists in providing an open receptacle in the underside of the body of the machine, in which rests an elongated missile retained in known manner by a pivoted strap, the free end of which may be released at will. The missile may be provided with a propeller to drive it through the air, or, if it be a torpedo, through the water; this propeller may be started in any known manner when the missile is dropped. The invention is described as applied to a hydro-aeroplane, from which a torpedo is intended to be dropped during flight. Willisch, A. von, Berlin.

No. 18816/12. Aerial machines with and without aerostats; planes, construction and arrangement of; parachutes. An aerial machine comprises a hull and planes both trough-shaped so as to act as parachutes. The hull may be closed beneath so as to form a balloon body of semicircular cross-section. Ailerons are hinged at the extremities of the planes and vertical planes are hinged above the hull and interconnected with the ailerons. Two rudders and landing-skids are fitted. Grages, F., Germany.

⊛ ⊛ ⊛ ⊛

Aeronautical Patents Published.

Applied for in 1913.

Published March 11th, 1915.

26,168. SIR A. T. DAWSON AND G. T. BUCKHAM. Mounting of Machine guns on aircraft.

Applied for in 1914.

Published March 11th, 1915.

13,490. J. BACHELOR. Braking, anchoring and starting aircraft.

⊛ ⊛ ⊛ ⊛

Index and Title Page for Vol. VI.

THE 8-page Index for Vol. VI of FLIGHT (January to December, 1914) is now ready, and can be had from the publishers, 44, St. Martin's Lane, London, W.C., price 6*d*.

FLIGHT.

44, ST. MARTIN'S LANE, LONDON, W.C.
Telegraphic address: Truditur, London. Telephone: 1828 Gerrard.

SUBSCRIPTION RATES.

FLIGHT *will be forwarded, post free, at the following rates:—*

UNITED KINGDOM.	s.	d.	ABROAD.	s.	d.
3 Months, Post Free...	3	9	3 Months, Post Free...	5	0
6 ,, ,, ...	7	6	6 ,, ,, ...	10	0
12 ,, ,, ...	15	0	12 ,, ,, ...	20	0

Cheques and Post Office Orders should be made payable to the Proprietors of FLIGHT, 44, St. Martin's Lane, W.C., *and crossed London County and Westminster Bank, otherwise no responsibility will be accepted.*

Should any difficulty be experienced in procuring FLIGHT *from local newsvendors, intending readers can obtain each issue direct from the Publishing Office, by forwarding remittance as above.*